

BONDO UNIVERSITY COLLEGE
UNIVERSITY EXAMINATION 2012/2013
1ST YEAR 2ND SEMESTER EXAMINATION FOR THE
DEGREE OF BACHELOR OF EDUCATION SCIENCE WITH
IT (REGULAR)

COURSE CODE: SCH 104

TITLE: BASIC ANALYTICAL CHEMISTRY

DATE: 30/11/2012

TIME: 8.00-10.00AM

DURATION: 2HOURS

INSTRUCTIONS

- 1) This paper contains FIVE [5] questions.**
- 2) Answer question ONE [1] COMPULSORY and ANY other TWO [2] questions.**
- 3) Write ALL answers in the booklet provided.**

Section A This section contains ONE COMPULSORY question

QUESTION 1 (Compulsory -30 marks)

- a) Explain each of the following terms (7 marks)
- Quantitative data
 - Fundamental units
 - Precipitation
 - Common ion effect
 - Co-precipitation
 - Limiting reagent
 - isotopes
- b) The mass of a hydrogen atom is 1.67×10^{-18} micrograms. What is the mass in pounds? (2 marks)
- c) The acceleration an object is stated as 32.3 ft/s^2 . What is the acceleration in/h? (3 marks)
- d) Replicate measurements are given as 2.680, 2.681, 2.680, 2,679 and 2.80 g. If the true value is 2.525 g. Calculate;
- The accuracy (2 marks)
 - Precision (2 marks)
- e) Predict whether precipitation takes place when the following pairs of solutions are mixed. Write the ionic equation where applicable: Lead(II) acetate + calcium hydroxide (2 marks)
- f) Naturally occurring sample of copper consists of 69.17% copper-63 which has an atomic mass of 62.9296 a.m.u. and 30.83% of copper-65 which has atomic mass of 64.9278 a.m.u. determine the relative atomic mass (R.A.M.) of copper. (3 marks)
- g) Calculate the solubility product of silver chromate given that its solubility is $2.5 \times 10^{-2} \text{ g/L}$. (RFM of $\text{Ag}_2\text{CrO}_4 = 331.7$) (6 marks)
- h) Determine the pH of a solution of ammonia containing $1.22 \times 10^{-5} \text{ mol/L}$ of OH^- ions (3 marks)

Section B: This section contains FOUR questions. Answer ONLY TWO questions.

QUESTION TWO (Optional, 20 marks)

- a) Discuss factors the influence solubility of a compound (8 marks)
- b) When KCl solution is added to a solution of AgNO_3 , a white precipitate is formed which dissolves in excess ammonia. Explain. (4 marks)
- c) The solubility product of CuS is $8.5 \times 10^{-45} \text{ mol}^2/\text{L}^2$ and that of FeS is $1.5 \times 10^{-19} \text{ mol}^2/\text{L}^2$. Briefly explain how a mixture of Cu(II) ions and Fe(II) ions may be separated using sulphide precipitation from a 0.01 M solution of metal ions in 0.25 M HCl. (8 marks)

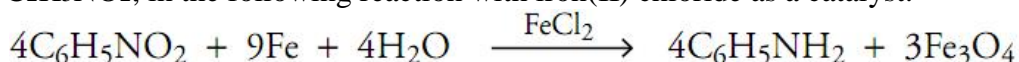
QUESTION THREE (Optional, 20 marks)

- a) A quarter tea spoonful (tsp) of a typical baking powder contains 0.4 g of NaHCO_3 .
- Calculate the molar mass of NaHCO_3 (2 marks)
 - Write the conversion factors that relate moles of NaHCO_3 and mass in grams of NaHCO_3 . (2 marks)
 - Calculate the number of moles of NaHCO_3 in 2.5 tsp of NaHCO_3 (3 marks)

- b) Tetraphosphorus decaoxide, P_4O_{10} may be obtained by combustion of phosphorus in oxygen. Determine the maximum mass of the oxide in tonnes that could be produced from 1.09×10^4 kg of phosphorus. (7 marks)
- c) Melamine is a compound used to in making melamine-formaldehyde resins in very hard surface materials such as FormicaTM. It consists of 6.63% carbon, 4.80% hydrogen and the rest is nitrogen. If the molecular mass of melamine is 126.121 determine the molecular formula of the compound. (6 marks)

QUESTION FOUR (Optional, 20 marks)

Aniline, $C_6H_5NH_2$, is used to make many different chemicals, including dyes, photographic chemicals, antioxidants, explosives, and herbicides. It can be formed from nitrobenzene, $C_6H_5NO_2$, in the following reaction with iron(II) chloride as a catalyst.



- What is the maximum mass of aniline, $C_6H_5NH_2$, in kg which can be formed from 810.5 kg of nitrobenzene, $C_6H_5NO_2$, with 985.0 kg of Fe and 250 kg of H_2O ? (10 marks)
- Identify the excess reagent(s) in question 5(a) above and explain why the reagent(s) was/were chosen to be in excess. (2 marks)
- If 478.2 kg of aniline, $C_6H_5NH_2$, are isolated from the reaction in 5(a) above, what is the percent yield? (2 marks)
- Explain why the actual yield in a chemical reaction is less than the theoretical yield. (4 marks)
- Does the reactant in excess affect the actual yield for a reaction? If it does, explain how. (2 marks)

QUESTION FIVE (Optional, 20 marks)

- The dissociation constant of ammonia is 1.8×10^{-5} . Determine:
 - The degree of dissociation of ammonia in a 0.1 M NH_3 the concentration of OH^- ions in 0.1 M ammonia solution (4 marks)
 - Percentage change in The degree of dissociation and concentration of OH^- ions by addition of 0.5 M NH_4Cl to 1 L of solution in above (4 marks)
 - The volume of 3.6×10^{-5} M HCl necessary to neutralize the ammonium solution in (a)ii) above (3 marks)
- Given $K_{sp}(Mg(OH)_2)$ is $1.5 \times 10^{-11} \text{ mol}^2/L^2$
 - Establish the minimum concentration and pH necessary to prevent precipitation of $Mg(OH)_2$ from 0.1 M Mg^{2+} ions from solution (4 marks)
 - Establish how much NH_4Cl should be added if 0.1 M NH_3 is used. (5 marks)

LIST OF CHEMICAL ELEMENTS

| Element | Symbol | Atomic no. | Atomic weight | Element | Symbol | Atomic no. | Atomic weight |
|-------------|--------|------------|---------------|--------------|--------|------------|---------------|
| Actinium | Ac | 89 | (227) | Mercury | Hg | 80 | 200.59 |
| Aluminium | Al | 13 | 26.981 539 | Molybdenum | Mo | 42 | 95.94 |
| Americium | Am | 95 | (243) | Neodymium | Nd | 60 | 144.24 |
| Antimony | Sb | 51 | 121.75 | Neon | Ne | 10 | 20.179 7 |
| Argon | Ar | 18 | 39.948 | Neptunium | Np | 93 | (237) |
| Arsenic | As | 33 | 74.921 59 | Nickel | Ni | 28 | 58.69 |
| Astatine | At | 85 | (210) | Niobium | Nb | 41 | 92.906 38 |
| Barium | Ba | 56 | 137.327 | Nitrogen | N | 7 | 14.006 74 |
| Berkelium | Bk | 97 | (247) | Nobelium | No | 102 | (255) |
| Beryllium | Be | 4 | 9.012 182 | Osmium | Os | 76 | 190.2 |
| Bismuth | Bi | 83 | 208.980 37 | Oxygen | O | 8 | 15.999 4 |
| Boron | B | 5 | 10.811 | Palladium | Pd | 46 | 106.42 |
| Bromine | Br | 35 | 79.904 | Phosphorus | P | 15 | 30.973 762 |
| Cadmium | Cd | 48 | 112.411 | Platinum | Pt | 78 | 195.08 |
| Caesium | Cs | 55 | 132.905 43 | Plutonium | Pu | 94 | (244) |
| Calcium | Ca | 20 | 40.078 | Polonium | Po | 84 | (209) |
| Californium | Cf | 98 | (251) | Potassium | K | 19 | 39.098 3 |
| Carbon | C | 6 | 12.011 | Praseodymium | Pr | 59 | 140.907 65 |
| Cerium | Ce | 58 | 140.115 | Promethium | Pm | 61 | (145) |
| Chlorine | Cl | 17 | 35.452 7 | Protactinium | Pa | 91 | 231.035 |
| Chromium | Cr | 24 | 51.996 1 | Radium | Ra | 88 | 226.025 4 |
| Cobalt | Co | 27 | 58.933 20 | Radon | Rn | 86 | (222) |
| Copper | Cu | 29 | 63.546 | Rhenium | Re | 75 | 186.207 |
| Curium | Cm | 96 | (247) | Rhodium | Rh | 45 | 102.905 50 |
| Dysprosium | Dy | 66 | 162.50 | Rubidium | Rb | 37 | 85.467 8 |
| Einsteinium | Es | 99 | (254) | Ruthenium | Ru | 44 | 101.07 |
| Erbium | Er | 68 | 167.26 | Samarium | Sm | 62 | 150.36 |
| Europium | Eu | 63 | 151.965 | Scandium | Sc | 21 | 44.955 910 |
| Fermium | Fm | 100 | (257) | Selenium | Se | 34 | 78.96 |
| Fluorine | F | 9 | 18.998 403 2 | Silicon | Si | 14 | 28.085 5 |
| Francium | Fr | 87 | (223) | Silver | Ag | 47 | 107.868 2 |
| Gadolinium | Gd | 64 | 157.25 | Sodium | Na | 11 | 22.989 768 |
| Gallium | Ga | 31 | 69.723 | Strontium | Sr | 38 | 87.62 |
| Germanium | Ge | 32 | 72.61 | Sulphur | S | 16 | 32.066 |
| Gold | Au | 79 | 196.966 54 | Tantalum | Ta | 73 | 180.947 9 |
| Hafnium | Hf | 72 | 178.49 | Technetium | Tc | 43 | (97) |
| Helium | He | 2 | 4.002 602 | Tellurium | Te | 52 | 127.60 |
| Holmium | Ho | 67 | 164.930 32 | Terbium | Tb | 65 | 158.925 34 |
| Hydrogen | H | 1 | 1.007 94 | Thallium | Tl | 81 | 204.383 3 |
| Iodine | I | 53 | 126.904 47 | Thulium | Tm | 69 | 168.934 21 |
| Indium | In | 49 | 114.82 | Thorium | Th | 90 | 232.038 1 |
| Iridium | Ir | 77 | 192.22 | Tin | Sn | 50 | 118.710 |
| Iron | Fe | 26 | 55.847 | Titanium | Ti | 22 | 47.88 |
| Krypton | Kr | 36 | 83.80 | Tungsten | W | 74 | 183.85 |
| Lanthanum | La | 57 | 138.905 5 | Uranium | U | 92 | 238.028 9 |
| Lawrencium | Lr | 103 | (260) | Vanadium | V | 23 | 50.941 5 |
| Lead | Pb | 82 | 207.2 | Xenon | Xe | 54 | 131.29 |
| Lithium | Li | 3 | 6.941 | Ytterbium | Yb | 70 | 173.04 |
| Lutetium | Lu | 71 | 174.967 | Yttrium | Y | 39 | 88.905 85 |
| Magnesium | Mg | 12 | 24.305 0 | Zinc | Zn | 30 | 65.38 |
| Manganese | Mn | 25 | 54.938 05 | Zirconium | Zr | 40 | 91.224 |
| Mendelevium | Md | 101 | (258) | | | | |