DEPARTMENT OF EDUCATION

UPPER SECONDARY SCHOOL CERTIFICATE EXAMINATIONS

CHEMISTRY

Tuesday

25 October 2011

Time allowed:

2 hours and 30 minutes

(8:00am – 10:30 am)

NO EXTRA TIME

(NO OTHER TIME)

Candidates are advised to fully utilise the allocated time

INSTRUCTIONS TO CANDIDATES

To be read by the external invigilator to all candidates

1. The subject code for **Chemistry** is **6**
2. There are **12** printed pages in the question booklet and **7 printed** pages in the answer booklet. The formula sheet is inserted in the middle of the question booklet.
3. There are two sections in this paper. Answer all questions.

   Section A : Multiple Choice Questions - 30 marks

   This section will be electronically marked.

   Electronic Answer Sheets will be distributed by your external invigilator. All answers to the Multiple Choice Section MUST be answered on this Answer Sheet.

   Carefully following the instructions, fill in your Candidate Information and Subject Information.

   Section B: Short Answer Questions - 70 marks

   Write down your name, your school name and your 10 digit candidate number on the Section B Answer Sheet Provided.
4. You are required to only write the correct answer in the spaces provided.
5. Calculators may be used.
6. Answers written on the question paper will not be marked. Write answers neatly in spaces as allocated on the answer sheet. Answer **ALL** questions.
7. Answer all questions on the answer sheet. Answers on any other paper including rough work paper and the question paper **will not be marked**
8. ALL working must be shown step by step to get full marks. Students may lose marks for writing down final answers only.
9. Enough spaces have been allocated for answers to every question. Questions must be answered in spaces as allocated. Answers all over the answer booklet may not be marked.
10. Correctional Fluid is not allowed on the answer sheet. Where you have made an error, cross out all the working and start on a new line.
11. Graphical Calculators are not permitted.

DO NOT TURN OVER THE PAGE AND DO NOT WRITE UNTIL YOU ARE TOLD TO START.

SECTION A (Questions 1 to 30)

For each question, choose the best answer and shade in the circle representing the letter of your choice A, B, C, D or E printed on the electronic answer sheet.

QUESTION 1

The volume of a gas at 800mm pressure and 30°C is 480 mL. What volume does the gas occupy at STP?

A. 2.19 mL B. 455.2 mL C. 455.2 L
D. 2.19 L E. 219.7 mL

QUESTION 2

Which of these is a physical process?

A. Burning of a candle. B. Tarnishing of copper.
C. Roasting of copper ore. D. Rusting of iron.
E. Dissolution of sugar in water.

QUESTION 3

Which of the following statement is true?

A. Solubility of gas in a liquid decreases when the temperature of the liquid decreases.
B. In general most solids dissolve in water move quickly at lower temperature.
C. If the pressure remains constant, the volume of a gas varies inversely with the absolute temperature.
D. If the temperature remains constant, the volume of a gas varies directly with pressure.
E. Separating funnel can be used to separate petrol from water.

QUESTION 4

A chemical bond is best thought of as

A. a chemical connection between two similar atoms to form compounds.
B. a chemical connection between two different atoms to form compounds.
C. an effect in which two atoms form an aggregate of atoms with distinctive properties.
D. an effect that causes two atoms to join to form a new entity having the same properties as the component atoms.
E. a chemical connection between two most electronegative atoms to form compounds.

QUESTION 5

The major reason for formation of compounds through ionic and covalent bonding is the

A. drive towards fulfilling the octet rule.

B. unique ability of atoms to gain or lose electrons.

C. ability of electrons in atoms to attract each other.

D. drive of atoms to become ions.

E. drive of atoms to attain higher energy.

QUESTION 6

The increase in ionization energy of elements across the periodic table is due to the

A. increase of atomic number and energy level making it harder to remove electrons.

B. decrease in energy level but increase in atomic number making it harder to remove electrons.

C. increase in number of protons and electrons for the same number of shells making it harder to remove electrons.

D. increase in atomic number for the same energy level and thus stability of the filled orbitals in the outer energy level making it harder to remove electrons.

E. increase in the number of neutrons for the same number of shells making it harder to remove neutrons.

QUESTION 7

In carrying out the combustion of a certain gaseous compound in oxygen, the following results were obtained.

	Reactants		**Products**	
	Gaseous compound	Oxygen	Water Vapour	Carbon dioxide
Mass of substance (g)	13	40	9	44

The masses of the substances involved illustrate

A. the Law of Multiple Proportions.

B. the Law of Constant Composition.

C. the Law of Conservation of Matter.

D. Avagadros Law.

E. the Law of Diffusion.

QUESTION 8

The coefficients that correctly balance the equation $aH_2S + bSO_2 \rightarrow cS + dH_2O$ are:

A. $a = 2$, $b = 1$, $c = 3$, $d = 2$

B. $a = 2$, $b = 4$, $c = 6$, $d = 3$

C. $a = 1$, $b = 1$, $c = 2$, $d = 2$

D. $a = 1$, $b = 2$, $c = 3$, $d = 1$

E. $a = 3$, $b = 2$, $c = 2$, $d = 3$

QUESTION 9

In the reaction between solutions of iron(III)chloride and sodium hydroxide, a solid product forms. The ionic equation for this precipitation reaction is

A. $Fe^{3+}(aq) + OH^{-}(aq) \rightarrow Fe(OH)_3(s)$

B. $Fe^{3+}(aq) + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s)$

C. $Fe^{3+}(aq) + 3Cl^{-} + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s) + 3Cl^{-}(aq)$

D. $Fe^{3+}(aq) + 3Na^{+}(aq) + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s) + 3Na(aq)$

E. $Fe^{3+}(aq) + 3NaCl(aq) + OH^{-}(aq) \rightarrow Fe(OH)_3(s) + 3NaCl(aq)$

QUESTION 10

Methanol is made according to the reaction given below:

$CO(g) + 2H_2 \rightleftharpoons CH_3OH(g) + heat$

To increase the amount of $CH_3O(g)$ we should:

A. increase the temperature.

B. decrease the temperature.

C. decrease the concentration of CO.

D. decrease the concentration of H_2.

E. decrease the pressure.

QUESTION 11

In an exothermic reaction:

A. Energy is absorbed.

B. Change in enthalpy is greater than zero.

C. Temperature of the surrounding drops.

D. Energy is released.

E. Energy is neither absorbed nor released

QUESTION 12

A student analyzed water samples from several sources and recorded her data in a table as shown. Which sample was the most acidic?

	Source of Water	**Sample volume (mL)**	**pH**
A	rain	5	5.7
B	creek	20	7.9
C	pool	10	7.4
D	water tap	20	6.8
E	distilled water	15	6.9

QUESTION 13

The table below contains a list of properties for an unidentified element *X* .

Physical Characteristics	Very soft with silvery white luster when cut.
Reactivity	Ignites in air and reacts violently with cold water.
Some common compounds	XCl, X_2SO_4, X_3PO_4, XOH, X_2O
Melting point (ºC)	39.1
Boiling point (ºC)	688

Based on the properties in the table, to which of the following groups from the periodic table does element X most likely belong?

A. I B. II C. III D. IV E. V

QUESTION 14

Which of these non-metals when in appropriate physical form conducts electric current?

A. oxygen B. chlorine C. sulfur

D. phosphorus E. carbon

QUESTION 15

The percentage (%) sodium in sodium hydrogen carbonate is:

A. 43.4 B. 0.274 C. 52.6 D. 27.4 E. 14.3

QUESTION 16

According to the following reaction,

$2CO_2(g) + O_2(g) \rightarrow 2CO_2(g)$,

the moles of CO_2 produced when 0.25 moles of O_2 reacts is:

A. 1 B. 2 C. 5 D. 0.25 E. 0.50

QUESTION 17

500mL of distilled water was used to prepare 0.2 $moldm^{-3}$ solution of sodium hydroxide (NaOH). What mass, in grams, of sodium hydroxide was needed?

A. 0.04 B. 4.0 C. 40.0 D. 8.0 E. 400.0

QUESTION 18

25mL of $Ba(OH)_2$ solution was titrated with 29.1mL of 0.040 mol L^{-1} HCl to reach neutralization. The molarity of the $Ba(OH)_2$ determined in mol L^{-1} was:

A. 0.0466 B. 0.466 C. 0.0233 D. 0.0344 E. 0.0172

QUESTION 19

Strong acids are covalent compounds and when dissociated in water produce

A. more hydroxide ions than hydrogen ions.

B. equal amounts of hydrogen and hydroxide ions.

C. hydroxide ions as the only negative ions in solution.

D. hydrogen ions as the only positive ions in solution.

E. hydroxide ions as the only positive ions in solution.

QUESTION 20

An aqueous sugar solution would turn the colour of a universal indicator to

A. red B. violet C. blue

D. yellow E. green

QUESTION 21

If concentrated sodium chloride solution (>2.0M) was electrolyzed the electrolysis product at the anode would be

A. hydrogen gas B. oxygen gas C. chlorine gas

D. sodium metal E. sodium chloride

QUESTION 22.

Which statement is not true?

A. In a galvanic cell, the anode is –ve.

B. In an electrolytic cell, the cathode is -ve.

C. In a galvanic cell, oxidation takes place at the anode.

D. Sometimes electricity can be produced by an electrolytic cell.

E. In an electrolytic cell, oxidation takes place at the anode.

QUESTION 23.

The best reason for the existence of millions of carbon compounds is that:

A. Carbon atoms can form four bonds to other atoms.

B. Carbon atoms can bond covalently in chains and rings.

C. Carbon atoms can form sp^3 hybridized orbital.

D. Carbon atoms can form sp hybridized orbital.

E. Carbon atoms have the electronic configuration $1s^2\ 2s^2\ 2p^2$.

QUESTION 24

Which of the following is NOT true of alkanes.

A. They are saturated hydrocarbons

B. They have general molecular formula C_nH_{2n}

C. They are found in natural gases and liquid petroleum

D. They have alkyl functional group.

E. They are not very reactive compared to alkenes.

QUESTION 25

Which of the following is NOT a hydrocarbon?

A. hexane B. ethene C. benzene

D. acetone E. ethane

QUESTION 26

Which is NOT a step in the production of copper?

A. smelting B. distillation C. roasting

D. bessemerization E. electro-refining

QUESTION 27

Fertilizers that are derived from plants are called

A. artificial fertilizers B. synthetic fertilizers C. plastic fertilizers

D. soluble fertilizers E. natural fertilizers

QUESTION 28

Which of the following is the better cleaning agent for washing clothes?

A. soaps B. acids C. detergents

D. bases E. alcohols

QUESTION 29

Which of these are sodium or potassium salts of long chain fatty acid?

A. soaps B. detergents C. fertilizers

D. PVC E. carboxylic acids

QUESTION 30

Which is NOT a step in petroleum refining?

A. desalting
B. fractional distillation
C. catalytic cracking
D. catalytic reforming
E. flotation

SECTION B (QUESTIONS 31 TO 40)

Write your answer to the questions in the spaces provided in your Section B Answer Booklet.

QUESTION 31

(a) A group of grade 12 students decide to have a party at the end of the year. In order to decorate the venue they fill balloons with hydrogen gas and helium gas. Hydrogen filled balloons took 28.4 hrs to go flat. How long would it have taken the helium filled balloons to go flat? (3 marks)

(b) The volume of a gas is 800mL at 1.05 atm. Calculate the volume of the same gas at 1.01 atm pressure. A constant temperature is maintained. (2 mark)

(c) The maximum amount of copper sulfate that can be dissolved in 45.0 gram of water at 70°C is 20.0 gram. What is the solubility of copper sulfate at that temperature (in gram/100g of water)? (2 marks)

QUESTION 32.

(a) (i) Draw the proton and electron arrangement in bonding between gold atoms. (1 mark)

(ii) Draw the outer shell diagram to show the bonding in the ammonium ion, NH_4^+. Also state the kind of bonding between the nitrogen and hydrogen atoms. (3 marks)

(b) Complete the following table on structure and bonding of substances. (3 marks)

Explanation of bonding	***Type of bonding and example***	***Appearance and state at 25°C***
_____	metallic eg: Au	shiny, solid, malleable and ductile
Positive and negative ions form a lattice.	_____	_____

QUESTION 33

(a) Balance the following equations. (2 marks)

(i) $H_2(g) + Br_2(g) \rightarrow HBr(g)$

(ii) $CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$

(b) State what type of reaction each of the following are. (3 marks)

(i) $CaCO_3(g) \rightarrow CaO(g) + CO_2(g)$

(ii) $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(g) + NaNO_3(aq)$

(iii) $C_2H_4(g) + Br_2(g) \rightarrow C_2H_4Br_2(l)$

(c) State whether the following salts are soluble or insoluble in water. (2 marks)

(i) Calcium carbonate

(ii) Copper (II) nitrate

QUESTION 34

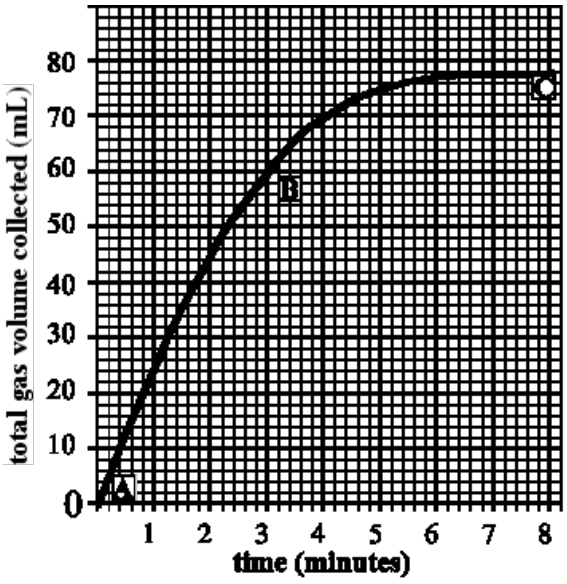
(a) What will be the effect of increased pressure in the following reaction and explain why?

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + heat$ (2 marks)

(b) What happens to the following system if the temperature is lowered?

$3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g) + heat$ (2 marks)

(c) Magnesium ribbon is reacting with an acid giving off hydrogen. The volume of gas collected against time is given in the graph below.



(i) How many minutes does it take to collect the first 35mL of hydrogen? (1 mark)

(ii) How many minutes does it take to collect the second 35 mL of hydrogen? (1 mark)

(iii) According to the graph, in which region (A, B or C) is the reaction the fastest? (1 mark)

QUESTION 35

(a) What are the properties of the following alloys?

(i) Stainless steel (1 mark)

(ii) Solder (1 mark)

(b) Name two effects of acid rain. (2 marks)

(c) What are three disadvantages of using chlorine in swimming pools? (3 marks)

QUESTION 36

(a) Calculate the average relative mass of chlorine. 75% chlorine atoms have a relative mass of 35 and 25% have a relative mass of 37. (2 marks)

(b) Work out the formula mass of ammonium sulfate, $(NH_4)_2SO_4$. (2 marks)

(c) Magnesium and sulfuric acid react to form magnesium sulfate and hydrogen as follows:

$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$

Calculate the mass of magnesium sulfate that would be obtained from 2 grams of magnesium. (3 marks)

QUESTION 37

(a) The chemical name for aspirin is 2-ethanoyloxybenzoic acid. This acid is soluble in hot water.

(i) How would you expect an aqueous solution of aspirin to affect a blue litmus paper? (1 mark)

(ii) Do you think aspirin is a strong acid or a weak acid? Explain. (2 marks)

(iii) What would you expect to see when sodium hydrogen carbonate (baking soda) is added to an aqueous solution of aspirin? (2 marks)

(b) Name the salt obtained from the following chemical reaction.

(i) Calcium hydroxide and nitric acid. (1 mark)

(ii) Copper oxide and sulfuric acid. (1 mark)

QUESTION 38

(a) Molten lead bromide undergoes electrolysis. Write the reactions occurring at the;

(i) anode: _____ (1 mark)

(ii) cathode:_____ (1 mark)

(iii) Overall reaction: _____ (1 mark)

(b) For the electroplating of silver, write the reaction occurring at the;

(i) anode: _____ (1 mark)

(ii) cathode:_____ (1 mark)

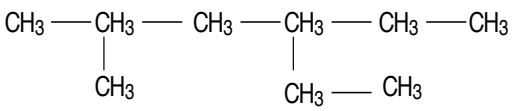
(c) Calculate the standard cell potential, Eº, of $Zn(s)/Zn^{2+}(aq)\ //Cu^{2+}(aq)/Cu(s)$ cell.

Eº Zn/Zn^{2+} = - 0.76V and Eº Cu/Cu^{2+} = +0.34V (2 marks)

QUESTION 39

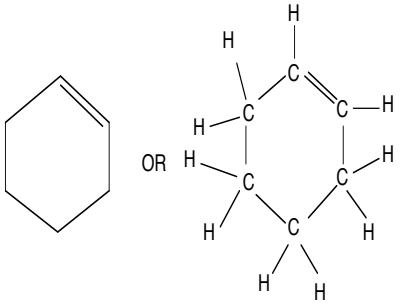
(a) Write the name of the following compounds using IUPAC rules.

(i)



(3 marks)

(ii)



(2 marks)

(b) Draw the structural formula for the compound; 2,2-dimethylbutane. (2 marks)

QUESTION 40

(a) In the Mond process for the extraction of nickel, 'nickel matte' is reacted with carbon monoxide to form a volatile compound, nickel tetracarbonyl.

Write a balanced equation of the reaction. (2 marks)

(b) From low grade ores, gold is extracted by reacting with cyanide solution, generally either sodium cyanide or potassium cyanide. The CN^- ions form a very strong complex with the gold Au^+ ions.

This complex $[Au(CN)_2]^-$ *(aq),* can be reduced back to *Au(s)* by treating with powdered zinc.

Write the balanced equation showing conversion of $[Au(CN)_2]^-$ to gold using zinc. (2 marks)

(c) Blister copper is further refined to obtain high purity copper using electrolysis. Write the reaction occurring at the anode and the cathode during the electrolysis. (2 marks)

(d) What is 'Cracking' in petroleum refining? (1 mark)

END OF EXAMINATION

CHEMISTRY DATA SHEET

1 mole of any element contains 6.02×10^{23} molecules

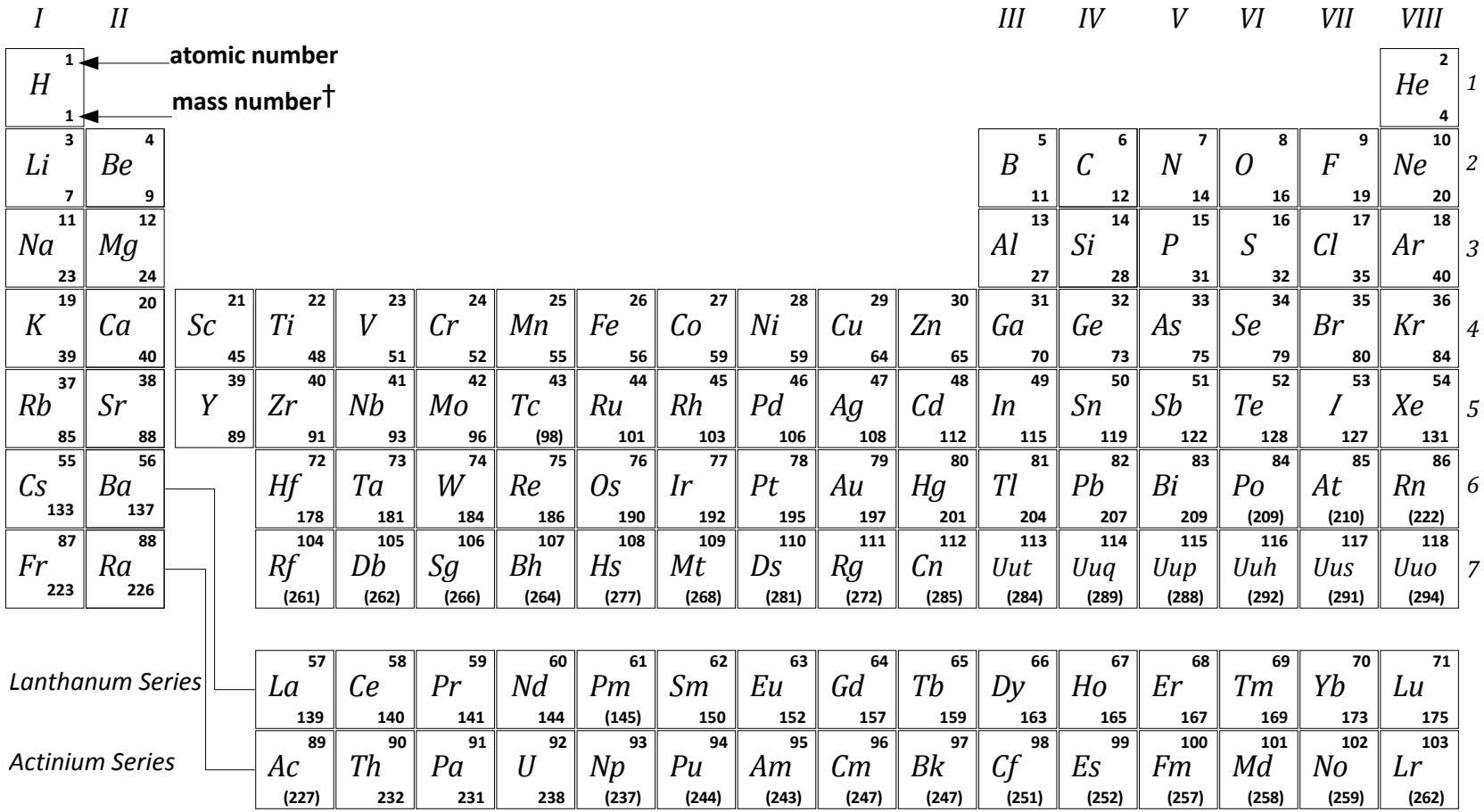
FORMULAE OF COMMON IONS	
Positive	**Negative**
Ag^{+}	Br^{-}
Al^{3+}	Cl^{-}
Ca^{2+}	CO_3^{2-}
Cu^{2+}	HCO_3^{-}
Fe^{2+}	HSO_4^{-}
Fe^{3+}	I^{-}
H^{+}	NO_3^{-}
K^{+}	O^{2-}
Li^{+}	OH^{-}
Mg^{2+}	S^{2-}
Na^{+}	SO_3^{2-}
NH_4^{+}	SO_4^{2-}
Pb^{2+}	PO_4^{3-}
Zn^{2+}	HPO_4^{3-}
Ba^{2+}	H_2PO^4

REACTIVITY SERIES	
Elements	**Reactivity**
Potassium	*Most reactive*
Sodium	
Lithium	↓
Calcium	
Magnesium	
Aluminium	
(Carbon)	
Zinc	*Decrease in Reactivity*
Iron	
Tin	↓
Lead	
(Hydrogen)	
Copper	
Silver	
Gold	
Platinum	*Least reactive*

SOLUBILITY OF SALTS AND HYDROXIDES IN COLD WATER

Soluble	Insoluble
All sodium, potassium and ammonium salts	
All nitrates	
Most bromides, chlorides & iodides	Bromides, chlorides & iodides of silver & lead*
Most sulphates	Sulphates of barium, calcium & lead*
Carbonates & hydroxides of sodium, potassium & ammonium	Most other carbonates & hydroxides
Calcium hydroxide is only slightly soluble	*lead salts are more soluble in hot water

Chemistry Data Sheet
The Periodic Table of Elements



† mass number relates to the commonest isotope.

For all calculations assume relative atomic mass = mass number, except for CHLORINE.
For chlorine, relative atomic mass = 35.5