

Class	Register Number	Name
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南洋女子中學校
NANYANG GIRLS' HIGH SCHOOL

**Mid-Year Examination 2016
Secondary Three**

CHEMISTRY

1 hour 30 minutes

0800-0930

Wednesday

11 May 2016

Additional materials: Writing papers

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, register number and class in the spaces at the top of this page.

Section A (MCQ)

Write your name, class and register number on the Multiple Choice Answer Sheet provided.

There are **twenty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the answer sheet.

Section B (Structured)

Answer **All** questions in the spaces provided on the Question Paper.

Section C (Short Answer)

Answer **All** questions in the spaces provided on the Question Paper.

Submit Multiple Choice Answer Sheet and Question Paper separately.

The intended number of marks is given in the brackets [] at the end of each question or part question. A copy of the Periodic Table is printed on page 17.

Examiner's Use	
Section A (20 marks)	
Section B (30 marks)	
Section C (10 marks)	
Total (60 marks)	

This document consists of **17** printed pages.

Setters: LSC, CJS

NANYANG GIRLS' HIGH SCHOOL

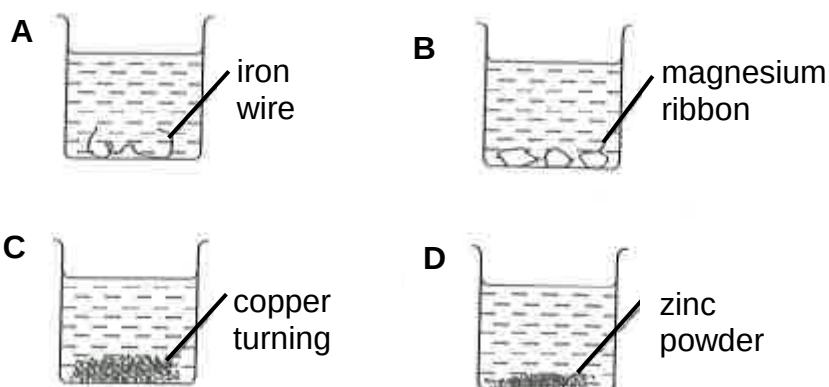
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Section A (20 marks)

Answer all questions. For each question there are four possible answers, A, B, C and D. Choose the one you consider correct and record your choice in soft pencil on the Multiple Choice Answer Sheet.

- 1** Different metals were added to dilute sulfuric acid.

In which beaker will a reaction **not** take place?



- 2** Alex was stung by an insect with an alkaline sting.

Which of the following substance is the most suitable for treating the insect sting?

- A** vinegar
- B** ethanol
- C** tooth paste
- D** cooking oil

- 3** Which of the following statements correctly describe a strong acid?

- I** It has a high pH value.
- II** It ionizes completely in water.
- III** It has a high concentration of hydrogen ions.
- IV** It exists as molecules in water.

- A** I and II only
- B** II and III only
- C** I and IV only
- D** III and IV only

4 Which two substances react to give a salt and water only?

- A iron and hydrochloric acid
- B potassium oxide and water
- C calcium carbonate and nitric acid
- D magnesium hydroxide and ethanoic acid

5 Which of the following gas when bubbled into water will give a pH greater than 7?

- A chlorine
- B hydrogen
- C ammonia
- D carbon monoxide

6 Which of the following solutions are correctly matched to their pH values?

pH	1	2	7	9	11
A	hydrochloric acid	lemon juice	sodium chloride	household soap	oven cleaner
B	lemon juice	hydrochloric acid	household soap	oven cleaner	sodium chloride
C	hydrochloric acid	lemon juice	sodium chloride	oven cleaner	household soap
D	lemon juice	hydrochloric acid	oven cleaner	household soap	sodium chloride

7 Ammonia gas is soluble in both water and trichloromethane, CHCl_3 .

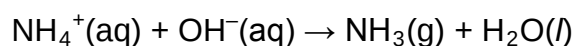
Which of the following shows the electrical conductivity for the two different solutions of ammonia?

	ammonia in water	ammonia in trichloromethane
A	conducts electricity	conducts electricity
B	conducts electricity	does not conduct electricity
C	does not conduct electricity	conducts electricity
D	does not conduct electricity	does not conduct electricity

- 8 Which of the following is the correct ionic equation for the reaction between sodium carbonate and dilute sulfuric acid?

- A $\text{SO}_4^{2-}(\text{aq}) + 2\text{Na}^+(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{s})$
- B $\text{CO}_3^{2-}(\text{aq}) + \text{H}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
- C $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
- D $\text{Na}_2\text{CO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow 2\text{Na}^+(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$

- 9 Which of the following mixture undergoes a reaction with the following ionic equation?



- A ammonium sulfate and limewater
 - B ammonium carbonate and vinegar
 - C ammonium nitrate and lead(II) hydroxide
 - D aqueous ammonia and hydrochloric acid
- 10 Alison added a solid to dilute hydrochloric acid in her attempt to prepare zinc chloride but failed.

Which of the following solid did she use?

- A zinc oxide
 - B zinc metal
 - C zinc nitrate
 - D zinc carbonate
- 11 Which of the following is true of amphoteric hydroxides?
- A They are soluble in water.
 - B They are gases at room temperature.
 - C They are insoluble in dilute nitric acid.
 - D They react with aqueous sodium hydroxide to form salts.
- 12 Which of the following can be used to identify the solutions in two unlabelled reagent bottles, one of which is aqueous ammonium chloride and the other contains aqueous ammonium carbonate?
- A dilute nitric acid
 - B aqueous ammonia
 - C aqueous lead(II) nitrate
 - D aqueous sodium hydroxide

- 13** An excess of aqueous sodium hydroxide is added to an aqueous solution of salt **X** and warmed. Ammonia gas is only given off after aluminium foil is added to the hot solution.

What could **X** be?

- A** sodium nitrate
- B** sodium chloride
- C** ammonium nitrate
- D** ammonium chloride

- 14** The results of two separate tests conducted on an aqueous solution of a salt are shown in the table below.

	test	results
1	Add aqueous ammonia dropwise then excess.	A dark green precipitate which did not dissolve in excess of aqueous ammonia. Precipitate turned reddish brown on standing.
2	Add dilute nitric acid followed by aqueous barium nitrate.	A white precipitate was formed.

What is the identity of the salt?

- A** iron(II) sulfate
- B** iron(II) chloride
- C** iron(III) sulfate
- D** iron(III) chloride

- 15** The table below shows the observations obtained on salts **X**, **Y** and **Z**.

salt tested	colour of salt	effect of adding aqueous sodium hydroxide dropwise till excess to a solution of the salt
X	white	no precipitate formed and no gas evolved on warming the mixture
Y	green	blue precipitate formed insoluble in excess
Z	white	white precipitate formed insoluble in excess

Which of the following contains the cations present in the three salts?

	X	Y	Z
A	sodium ion	iron(II) ion	lead(II) ion
B	sodium ion	copper(II) ion	calcium ion
C	ammonium ion	iron(II) ion	lead(II) ion
D	ammonium ion	copper(II) ion	calcium ion

- 16** Which of the following compound contains both ionic and covalent bonds?
- A** zinc oxide
B potassium sulfide
C iron(II) chloride
D calcium hydroxide
- 17** Which of the following covalent molecules does **not** form a solution containing mobile ions in water?
- A** HCl/
B CH₄
C CO₂
D SO₂
- 18** The table below shows electrical conductivity and melting points of three substances, **P**, **Q** and **R**.

substance	electrical conductivity			melting point/ °C
	solid	molten	aqueous solution	
P	no	no	no	-117
Q	no	no	no	80
R	no	yes	yes	801

What are the types of bonding found in substances **P**, **Q** and **R**?

	P	Q	R
A	covalent	metallic	ionic
B	ionic	covalent	metallic
C	covalent	covalent	ionic
D	metallic	ionic	metallic

- 19** The table below shows the number of electrons and neutrons for ion G^{2-} , H^+ , L^- and M^{2+} . These letters are not the actual symbols of the elements.

ions	number of electrons	number of neutrons
G^{2-}	10	11
H^+	10	12
L^-	18	18
M^{2+}	18	20

Which of the following gives the correct nucleon number of the ion?

	ion	nucleon number
A	G^{2-}	21
B	H^+	21
C	L^-	35
D	M^{2+}	36

- 20** The table below shows the proton number of two elements, **X** and **Y**.

element	proton number
X	15
Y	17

Which statement about **X** and **Y** is correct?

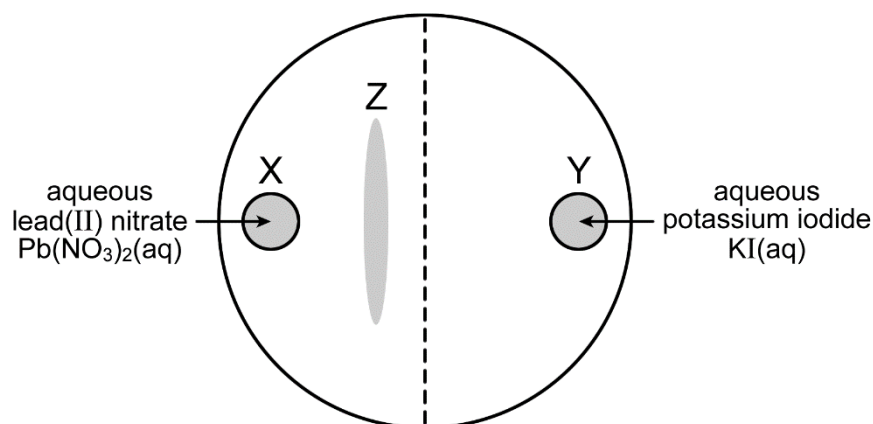
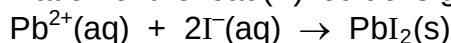
- A** **X** and **Y** form an ionic compound X_3Y .
- B** **X** and **Y** form an ionic compound XY_3 .
- C** **X** and **Y** form a covalent compound X_3Y .
- D** **X** and **Y** form a covalent compound XY_3 .

Section B (30 marks)

Answer all questions in this section in the spaces provided.

- B1** A petri dish was filled with distilled water at 25°C. Three drops of aqueous lead(II) nitrate were carefully added at point **X** and three drops of aqueous potassium iodide were carefully added at point **Y** at the same time. After 90 seconds, a yellow precipitate of lead(II) iodide started to form at point **Z**.

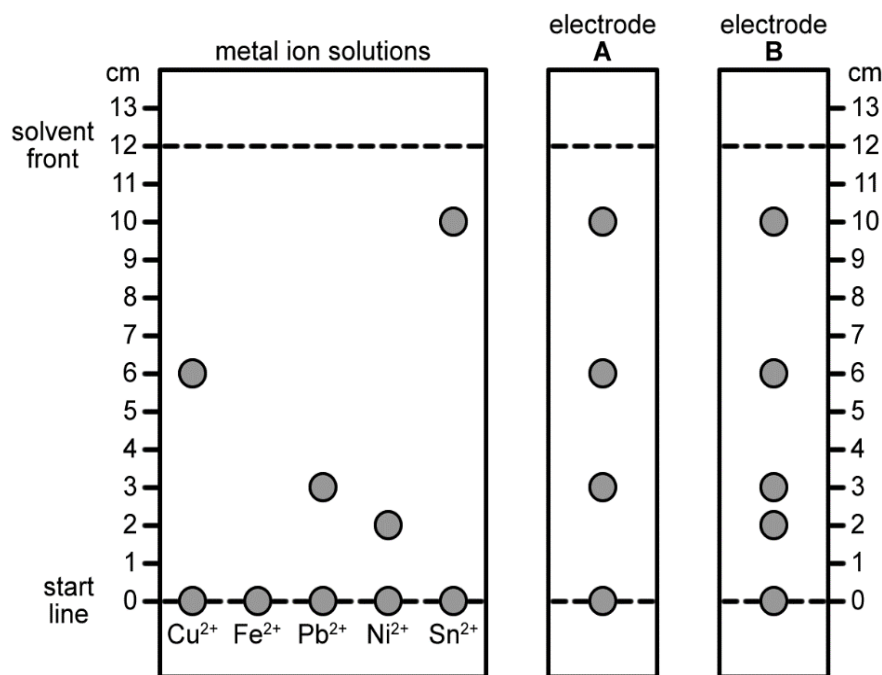
The ionic equation for formation of the lead(II) iodide is given below:



- (a) Name the process by which a chemical spreads from a region of high concentration to a region of lower concentration. [1]
-
- (b) Explain why the precipitate forms at point **Z** and **not** exactly half-way between points **X** and **Y** (indicated by the dashed line). [1]
-
- (c) State one difference that would be observed if the three drops of aqueous lead(II) nitrate were replaced with three drops of aqueous silver nitrate. [1]
-
- (d) State one difference that would be observed if the experiment was repeated at 15°C. [1]
-

Total [4]

B2 Electrodes **A** and **B**, from two different lead-acid batteries, were tested to see if they are from the same manufacturer. Samples from the two electrodes were dissolved in a suitable acid and the resulting solutions were chromatographed, together with solutions containing five known metal ions. After treating with a locating agent, the chromatograms were as shown below.



(a) Suggest why a locating agent is needed in this experiment. [1]

(b) Which metal ions are present in both electrode **A** and electrode **B**? [1]

(c) Were electrodes **A** and **B** from the same manufacturer? Give a reason for your answer. [1]

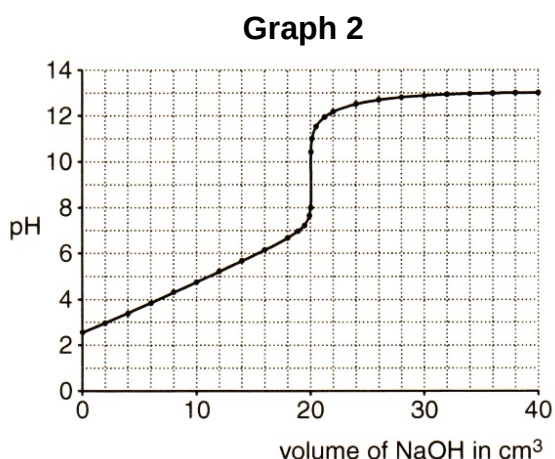
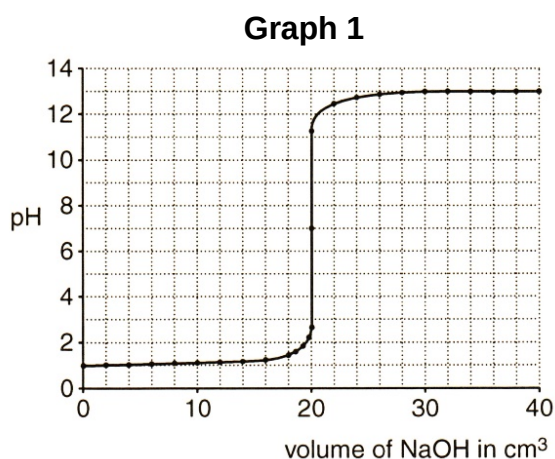
(d) On the chromatograms above, add the "spot" for Fe^{2+} , which has an R_f value of 0.75. [1]

Total [4]

B3 The graphs below show the pH curves for two acid-alkali titrations.

Graph 1 shows the pH curve obtained when excess 1.0 mol/dm^3 sodium hydroxide was added to 1.0 mol/dm^3 hydrochloric acid in a conical flask.

Graph 2 shows the pH curve obtained when excess 1.0 mol/dm^3 sodium hydroxide was added to 1.0 mol/dm^3 ethanoic acid in a conical flask.

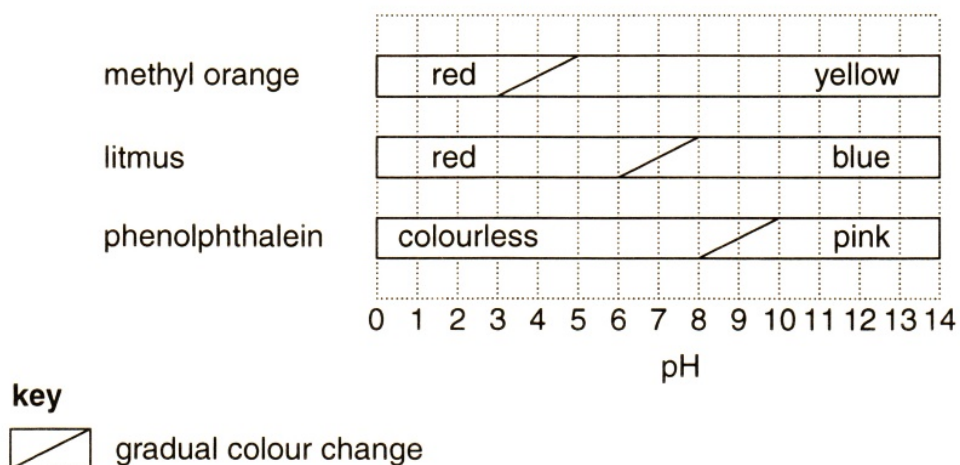


- (a) In both experiments, equal volumes of acid and alkali reacted together to form a neutral solution. For the reaction between hydrochloric acid and sodium hydroxide, what is the total volume of solution present in the conical flask at pH 7? [1]

- (b) With reference to the graphs, what evidence suggests that the aqueous sodium hydroxide was added in excess? [1]

- (c) With reference to the graphs, what evidence suggests that ethanoic acid is a weak acid? [1]

- (d) The table below shows the pH values at which some common indicators change colour.



With reference to the pH curves given in **Graph 1** and **Graph 2**, which indicator(s) can be used to show the end-point of the reaction between

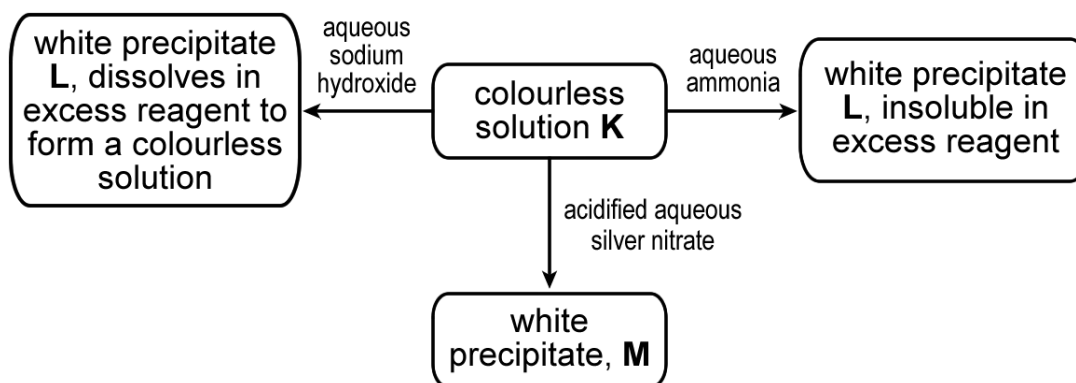
- (i) hydrochloric acid and aqueous sodium hydroxide? [1]

- (ii) ethanoic acid and aqueous sodium hydroxide? [1]

- (e) Write the ionic equation for the neutralisation reaction between an acid and an alkali. [1]

Total [6]

- B4** Study the qualitative analysis shown below and then answer the questions that follow.



- (a) Solution **K** is colourless. Based on this observation, which three cations are confirmed to be **absent** from solution **K**? [1]
-
- (b) Give the name of precipitate **M**. [1]
-
- (c) Why is it **not** possible for solution **K** to contain the lead(II) ion, $\text{Pb}^{2+}(\text{aq})$? [1]
-
- (d) Give the identity of precipitate **L**. [1]
-
- (e) Give the formulae of the anion and the cation present in solution **K**. [2]
-
- (f) Write the balanced chemical equation, including state symbols, for the reaction between solution **K** and aqueous sodium hydroxide to form precipitate **L**. [1]
-
- (g) Write the ionic equation for the formation of precipitate **M**. [1]
-

Total [8]

- B5 (a)** Chlorine reacts with sulfur to form the red liquid, sulfur dichloride. Sulfur dichloride melts at -121°C and boils at 59°C .

(i) Draw the Lewis diagram to show the bonding in sulfur dichloride. [2]

(ii) Using your knowledge of chemical bonding, explain why sulfur dichloride is a liquid at room temperature and pressure. [2]

- (b)** Chlorine also reacts with magnesium to form the white solid, magnesium chloride. Magnesium chloride melts at 714°C and boils at 1412°C .

(i) Draw the Lewis diagram to show the bonding in magnesium chloride. [2]

- (ii) Using your knowledge of chemical bonding, explain why magnesium chloride does not conduct electricity in its solid state, but is a good conductor of electricity when molten. [2]

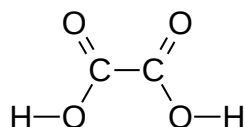
Total [8]

Section C (10 marks)

Answer all questions in this section.

Write your answers on the separate writing paper provided.

- C1** The structural formula of oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$, is given below.



Oxalic acid occurs naturally in some leafy green vegetables. If oxalic acid is consumed in large quantities by humans, it can react with calcium ions in the body to form the salt calcium oxalate, CaC_2O_4 . Calcium oxalate is insoluble in water and can precipitate in the kidneys causing kidney stones.



- (a)** Pure oxalic acid is a white crystalline solid. Explain why pure oxalic acid will not react with powdered sodium carbonate to produce a salt, water and carbon dioxide. [1]

- (b)** Oxalic acid is a weak acid. Define the term “weak acid”. [1]

- (c)** Oxalic acid is a dibasic acid.

- (i)** Write the balanced chemical equation for the reaction between oxalic acid and sodium hydroxide to form sodium oxalate and water. [1]

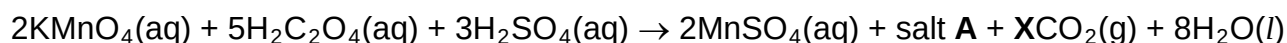
- (ii) Do you expect sodium oxalate to be soluble or insoluble in water? [1]
Explain your answer.

- (d) A doctor wants to prepare a pure, dry sample of calcium oxalate so that she can study its toxic properties.

- (i) Name a chemical that could be added to aqueous oxalic acid to form calcium oxalate. [1]

- (ii) Calcium oxalate is insoluble in water. Briefly describe the experimental procedure that the doctor should follow in order to prepare a pure, dry sample of calcium oxalate. [3]

- (e) Oxalic acid reacts with acidified potassium manganate(VII) according to the following chemical equation.



- (i) Give the formula of salt A that is produced during the reaction. [1]

- (ii) What value must the coefficient X have in order to balance the chemical equation? [1]

Total [10]

End of paper

Group																		
I	II						III	IV	V	VI	VII	0						
		1 H hydrogen 1												4 He helium 2				
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10	
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18	
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	64 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36	
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	101 Ru ruthenium 44	101 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	127 I iodine 53	128 Te tellurium 52	131 Xe xenon 54		
133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	210 Po polonium 84	210 At astatine 85	222 Rn radon 86	
87 Fr francium	88 Ra radium	89 Ac actinium																

Key

a	a = relative atomic mass
X	X = atomic symbol
b	b = proton (atomic) number

a **X** c

The volume of one mole of any gas is 24 dm^3 at room temperature and

140	Ce	cerium	58	141	Pr	praseodymium	59	144	Nd	neodymium	60	-	Pm	promethium	61	150	Sm	samarium	62	152	Eu	euporium	63	157	Gd	gadolinium	64	159	Tb	terbium	65	162	Dy	dysprosium	66	165	Ho	holmium	67	167	Er	erbium	68	169	Tm	thulium	69	173	Yb	ytterbium	70	175	Lu	lutetium	71
232	Th	thorium	90	-	Pa	protactinium	91	238	U	uranium	92	-	Np	neptunium	93	-	Pu	plutonium	94	-	Am	americium	95	-	Cm	curium	96	-	Bk	berkelium	97	-	Cf	californium	98	-	Es	einsteinium	99	-	Fm	fermium	100	-	Md	mendelevium	101	-	No	nobelium	102	-	Lr	lawrencium	103