Established in 1879

Raffles Girls' School
(SECONDARY)

Name: _____

Class: 4 / _____ Register No: _____

CHEMISTRY
RAFFLES PROGRAMME/RAFFLES ACADEMY (STANDARD)
YEAR FOUR

End-of-Year Assessment

Monday **19 September 2016** **1h 45 min**

INSTRUCTIONS TO CANDIDATES

This question paper contains two sections.

Section A - Answer **ALL** the questions and record your answers on the OMR answer sheet.

Section B - Answer **ALL** the questions and write your answers in the spaces provided.

Use only a black or dark blue pen.

Do not use correction tape or fluid.

Omission of essential working or units, or expressing answers with incorrect significant figures will result in a loss of marks.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question. The total number of marks for this paper is 70.

A copy of the Periodic Table on page 20 is provided for your reference.

For examiners' use	
Section / Question	**Marks Obtained**
A	
B1	
B2	
B3	
B4	
B5	
B6	
B7	
Working	
Units	
Significant Figures	
Total	**70**

Parents's / guardian's Name: _____

Signature: _____ Date: _____

Section A – Multiple Choice Questions [15 marks]

*There are 15 questions in this section. Answer all questions. For each question, there are four possible answers (**A**, **B**, **C**, and **D**). Choose the most appropriate answer and record your choice on the OMR answer sheet.*

1 Which reagent can be used to distinguish between aqueous solutions of sodium sulfate and sodium chloride?

A barium nitrate
B lead(II) nitrate
C dilute nitric acid
D potassium manganate(VII)

2 A yellow precipitate was formed when aqueous lead(II) nitrate was added to a colourless solution **X**. What could **X** be?

A iron(II) iodide
B sodium iodide
C calcium chloride
D copper(II) chloride

3 Solutions of magnesium nitrate, iron(II) nitrate and silver nitrate were added with metals **P**, **Q**, **R** and **S** respectively. The observations are shown in the table below.

	P	**Q**	**R**	**S**
$Mg(NO_3)_2$ (aq)	No change observed.	No change observed.	Magnesium was formed.	No change observed.
$Fe(NO_3)_2$ (aq)	No change observed.	Iron was formed.	Iron was formed.	No change observed.
$AgNO_3$ (aq)	No change observed.	Silver was formed.	Silver was formed.	Silver was formed.

Which is the order of reactivity of the four metals in descending order?

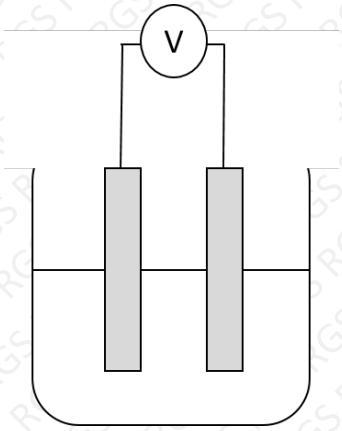
A **P** > **Q** > **R** > **S**
B **S** > **R** > **Q** > **P**
C **R** > **Q** > **S** > **P**
D **P** > **S** > **Q** > **R**

4 Iron can be extracted from haematite in a blast furnace. Which statements are correct?

I. Carbon monoxide is used to reduce iron(III) oxide to iron.
II. Waste gases include carbon dioxide and carbon monoxide.
III. Sodium carbonate is used to remove impurities.
IV. Coke is one of the raw materials used.

A Statements I and II only
B Statement I, II and III only
C Statement I, II and IV only
D All of the above statements

5 Which pair of metals **X** and **Y** will produce the highest voltage in the simple cell shown below?

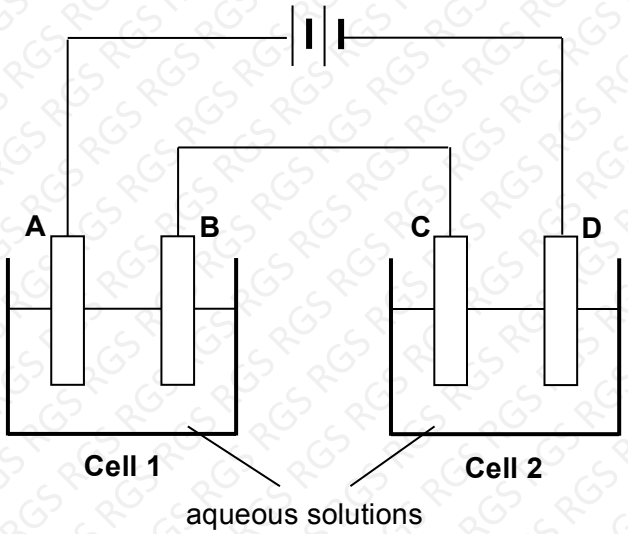


A	Cu	Ag
B	Mg	Ag
C	Mg	Fe
D	Zn	Fe

6 Electrolysis of rubidium nitrate solution was carried out. What could be the products liberated at each electrode?

	At the cathode	**At the anode**
A	Rubidium	Nitrogen
B	Rubidium	Oxygen
C	Hydrogen	Nitrogen
D	Hydrogen	Oxygen

7 In the diagram below, each cell contains a salt solution with platinum as the electrodes. If the increase in mass of electrode **B** is greater than the increase in mass of electrode **D** in the same time, which could be the identities of the salt solution in **Cell 1** and **Cell 2**?



	Cell 1	Cell 2
A	Sodium chloride solution	Iron(II) nitrate solution
B	Aluminium nitrate solution	Lead(II) nitrate solution
C	Potassium chloride solution	Zinc nitrate solution
D	Silver nitrate solution	Copper(II) sulfate solution

8 Hydrogen reacts with chlorine as shown in the equation below:

$$H_2\,(g) + Cl_2\,(g) \rightarrow 2HCl\,(g) \qquad \Delta H = -184\ kJ\ mol^{-1}$$

Which statement best explains the negative sign of ΔH?

A The products possess more energy than the reactants.
B The number of bonds form are more than the number of bonds broken.
C The total energy change in bond breaking is less than that of bond forming.
D The total energy change in bond breaking is more than that of bond forming.

9 Which of the following equations below represent exothermic processes?

I. $H_2O\,(g) \rightarrow H_2O\,(l)$
II. $C_2H_6\,(g) \rightarrow 2C\,(s) + 6H\,(g)$
III. $CaCO_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g)$
IV. $C_6H_{12}O_6\,(s) + 6O_2\,(g) \rightarrow 6CO_2\,(g) + 6H_2O\,(l)$
V. $2C_4H_{10}\,(g) + 13O_2\,(g) \rightarrow 8CO_2\,(g) + 10H_2O\,(s)$

A I, III and V
B I, IV and V
C II, III and IV
D II, IV and V

Use the following information to answer questions 10 and 11.

Three experiments were carried out to compare the rate of reaction of magnesium with equal volume of different dilute acids with the same concentration.

The different variables and time taken to produce a fixed volume of 30 cm^3 of hydrogen gas for each experiment were tabulated below.

Experiment	I	II	III
Type of acid	H_2SO_4	HC*l*	HC*l*
Number of copper(II) sulfate drops	0	0	5
Time taken/s	30	60	15

10 Which one of the following statements best explains why the time taken to produce hydrogen gas is shorter in **Experiment I** than in **Experiment II**?

A H_2SO_4 is in excess while HC*l* is the limiting reagent.
B H_2SO_4 is dibasic while HC*l* is monobasic.
C Reaction between H_2SO_4 and Mg is more exothermic than reaction between HC*l* and Mg.
D Sulfate ion has larger ionic radius than chloride ion resulting in weaker force of attraction between sulfate ion and hydrogen ion.

11 Which one of the following statements best explains why the time taken to produce hydrogen gas is shorter in **Experiment III** than in **Experiment II**?

A Copper(II) sulfate is used as a catalyst to speed up reaction rate.
B Copper(II) sulfate reacts with the acid to produce more hydrogen ions to react with magnesium.
C Magnesium reacts with copper(II) sulfate to form magnesium ions, which react more vigorously with the acid.
D Copper(II) sulfate reacts with the acid to form hydrogen ions contributing to a higher concentration of hydrogen ions.

12 Which statement is true about ethanol?

A It reacts with copper.
B It is a saturated compound.
C It reacts with ethyl ethanoate to form an acid.
D It is formed by the catalytic substitution of steam to ethene.

13 Which gas is **not** produced when hydrocarbons are burnt in the internal combustion engine?

A Ozone
B Nitrogen oxides
C Carbon dioxide
D Carbon monoxide

14 The table below shows the observations made when compound **Y** was added to different reagents. What could **Y** be?

Reagents	Observations
Ca (s)	Effervescence observed
Na_2CO_3 (aq)	Effervescence observed
Br_2 (aq), in the dark	Solution remained brown
Acidified $KMnO_4$ (aq)	Solution remained purple

A Propene
B Butanoic acid
C 2-chloropentane
D 2-methylpropane

15 In which reaction does the product have more carbon atoms than the reactant?

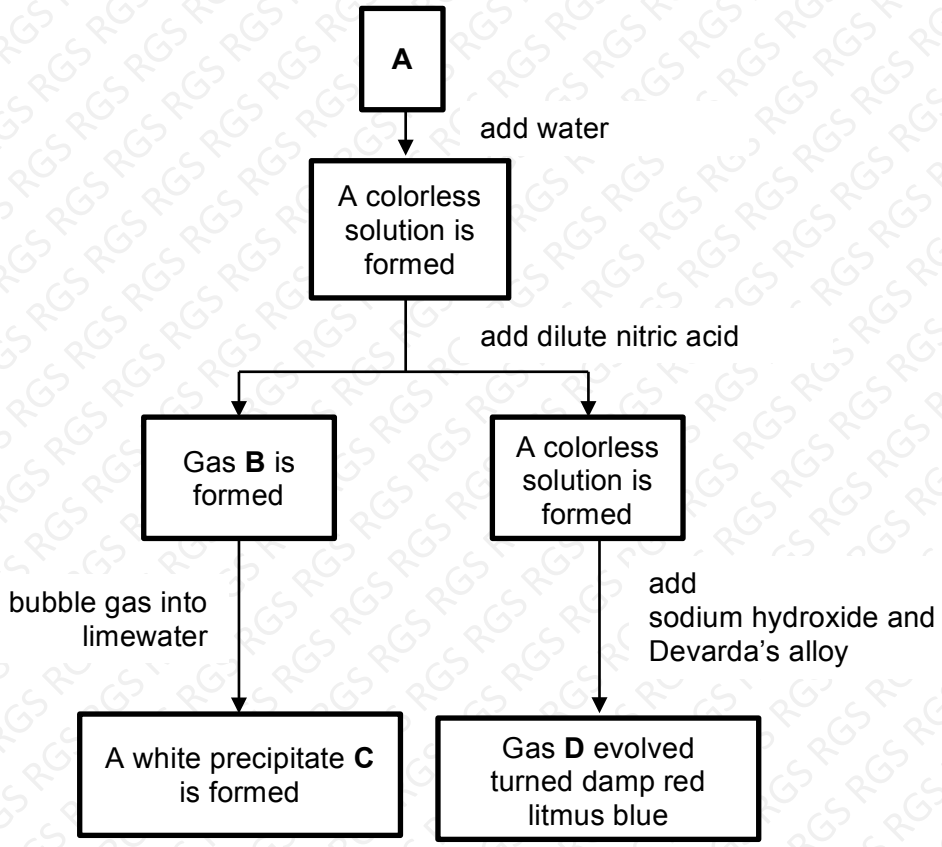
	Product	Reactant
A	Ester	Carboxylic acid
B	Salt	Carboxylic acid
C	Alkene	Alcohol
D	Carboxylic acid	Alcohol

— End of Section A —

Section B (55 Marks)

*Answer **ALL** questions and write your answers in the spaces provided.*

B1 Substance **A** is a mixture of two sodium salts. The figure below shows the steps taken to identify the two salts.



(a) Identify **B**, **C** and **D**. [3]

B: ……

C: ……

D: ……

(b) Identify the ion that caused the formation of gas **D.** [1]

……

(c) The formation of gas **D** does **not** prove that the ion stated in **(b)** is present in substance **A**. Explain why. [1]

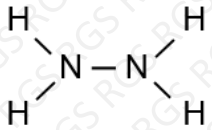
……

……

B2 Hydrazine, N_2H_4 when mixed with hydrogen peroxide, H_2O_2 can be used as a rocket propellant. The reaction is as follows:

$$N_2H_4\ (g) + 2\ H_2O_2\ (g) \rightarrow N_2\ (g) + 4\ H_2O\ (g)$$

The structural formulae of N_2H_4 and H_2O_2 are shown below.



N_2H_4

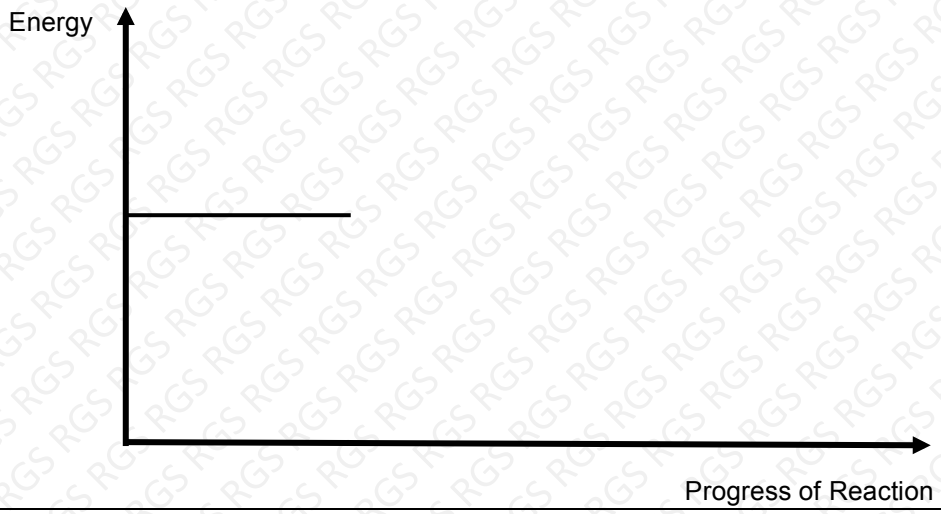
H_2O_2

The table below shows the average bond energies of various bonds.

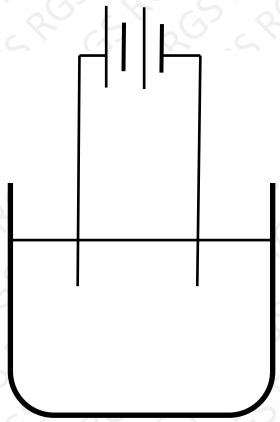
Bond	N-H	N-N	N≡N	H-O	O-O
Average bond energy / kJ mol^{-1}	388	163	944	463	146

(a) Calculate the enthalpy change for the reaction of 1 mole of hydrazine with hydrogen peroxide. [3]

(b) Draw a well-labelled energy profile diagram of the reaction above using the axes below. [3]



B3 An experiment was set up to electroplate an object with copper. A carbon rod was used as the anode. The electrolyte used was copper(II) sulfate solution. Using a circle ◯ to represent the object and a shaded rod ▮ to represent the carbon rod, complete the set-up of the experiment. [1]



(a) Write the half equations, including state symbols for the reaction taking place at the cathode and the anode. [2]

Anode : …..……

Cathode : …..……..……

(b) State the color change of the electrolyte after running the experiment for some time. Explain why. [2]

……..……..

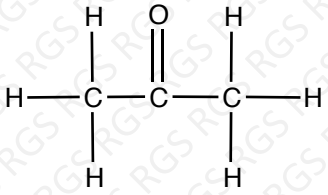
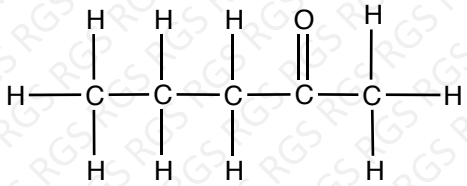
……..

……..……..

(c) The final amount of copper deposited at the cathode was 0.0200 mol. Calculate the volume of the gas produced at the anode at room temperature and pressure. [2]

B4 The table shows some information about the homologous series of a class of organic compounds called ketones.

(a) Fill in the blanks in the table below. [4]

Name	Condensed Formula	Full Structural Formula	Boiling point/ ^{o}C
2-propanone			56.0
	$CH_3CH_2COCH_3$		79.6
2-pentanone	$CH_3CH_2CH_2COCH_3$		

(b) Circle the functional group in the structure of **2-propanone** and explain the term homologous series, with reference to ketones. [2]

……

……

……

(c) State and explain the trend in the boiling points of ketones. [2]

……

……

……

B5 The odours and flavors of fresh fruits are a result of many chemical compounds with esters as one of the major constituents. Ester **Z** is found in apples and can be manufactured by the reaction of methanol with butanoic acid.

(a) Name ester **Z** and draw its full structural formula. [2]

Name: ……

(b) Butanoic acid can be formed from its corresponding alcohol.

(i) State the reagent(s), condition(s) and observation(s) for this reaction. [3]

Reagent(s):	
Condition(s):	
Observation(s):	

(ii) State the type of reaction that occurs in **b(i)**. [1]

……

B6 During cracking, molecules of nonane, C_9H_{20}, produce three different products: butane, ethene and product **Q**.

(a) (i) Draw the full structural formulae of the three products in the table below. [3]

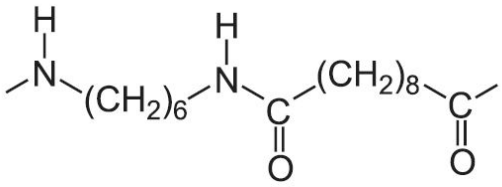
butane	ethene	product **Q**

(ii) Ethene is an unsaturated compound. State the reagent(s) and condition(s) required to convert ethene to a saturated compound. [1]

……

(iii) Product **Q** undergoes addition polymerization to form a polymer. Draw the structural formula of this polymer, showing at least one repeating unit. [1]

(b) Nylon-6,10 is commonly used as electrical insulators and precision parts due to its low moisture absorption and high chemical resistance. The structure of a section of Nylon-6,10 is shown below.



Draw the structural formula of two monomers from which Nylon-6,10 can be made. [2]

B7 Brass is an alloy made of copper and zinc. Given 1.15 g of brass, a student was asked to suggest a method to determine the mass of copper and zinc in it.

(a) A student proposed adding excess concentrated nitric acid to the brass. A colorimeter will then be used to analyse the colour intensity of copper(II) nitrate solution formed.

(i) Concentrated nitric acid reacts with copper to form copper(II) nitrate, nitrogen dioxide and water. Construct a balanced chemical equation for the reaction. [1]

……

(ii) The above reaction is a redox reaction. State the oxidising agent and explain your answer. [2]

……

……

(b) A colorimeter measures the amount of light absorbed when the light passes through a coloured solution. **Figure 7.1** below shows how a colorimeter works.

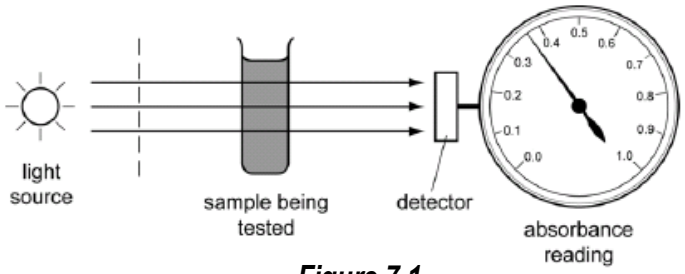


Figure 7.1

The absorbance reading correlates with the concentration of the solution. The higher the concentration, the darker the colour of the solution, more light is absorbed, which corresponds to higher absorbance reading.

The student first generated a calibration curve for copper(II) nitrate absorbance by preparing copper(II) nitrate solutions of known concentrations. A graph of absorbance against concentration of copper(II) nitrate solutions was plotted as shown in **Figure 7.2** below.

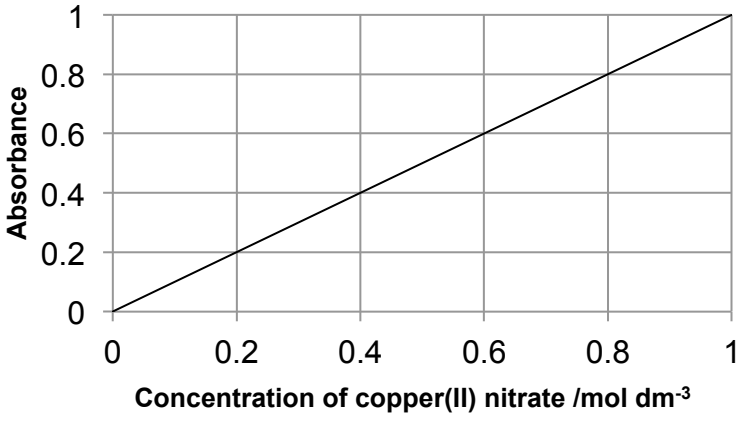


Figure 7.2

The student then proceeded to add excess concentrated nitric acid to the given brass and recorded the absorbance reading upon completion of reaction. She repeated the experiment twice with the results tabulated in **Table 7.1**.

20 cm^3 of copper(II) nitrate solution was obtained upon completion of the reaction.

Reading	Absorbance
1	0.59
2	0.62
3	0.59

Table 7.1

(i) Using **Figure 7.2** and **Table 7.1**, calculate the number of moles of copper(II) nitrate. [2]

(ii) Calculate the mass of copper and zinc present in the brass. [2]

(c) The speed of reaction between powdered zinc and dilute hydrochloric acid was investigated at room temperature and pressure. The volume of gas evolved was recorded every ten seconds as shown in **Figure 7.3** below.

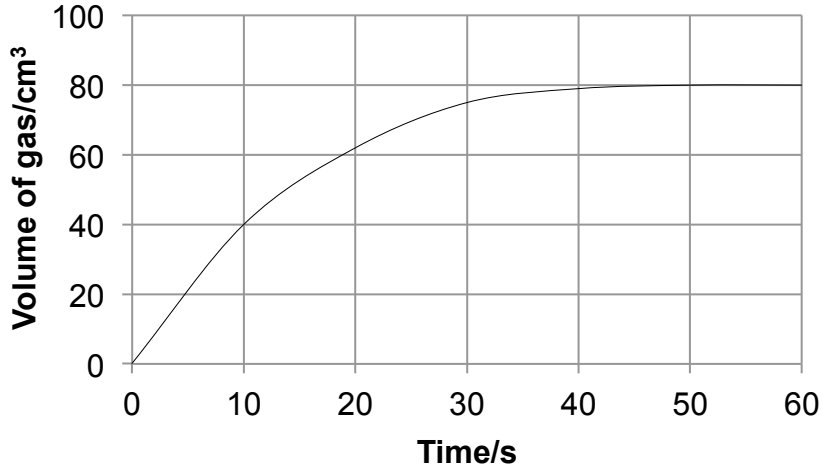


Figure 7.3

(i) Construct a balanced chemical equation, with state symbols for the reaction. [2]

……

(ii) 0.5 g of zinc was added to 100 cm^3 of 0.100 mol/dm^3 hydrochloric acid. Determine the limiting reagent. Calculate the percentage yield of the product gas evolved. [3]

(iii) The experiment was repeated with temperature at 50 ^{0}C. Sketch the graph in **Figure 7.3** and label it as **X**. Explain your answer using collision theory. [4]

……

……

……

……

……

……

……

End of Section B

- Blank Page -

- Blank Page -

Blank Page -

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1.0 H hydrogen 1										4.0 He helium 2
6.9 Li lithium 3	9.0 Be beryllium 4											10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12											27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulphur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	– Tc technetium 43	101 Ru ruthenium 44	103 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	128 Te tellurium 52	127 I iodine 53	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	– Po polonium 84	– At astatine 85	– Rn radon 86
– Fr francium 87	– Ra radium 88	– Ac actinium 89 * *	– Rf rutherfordium 104	– Db dubnium 105	– Sg seaborgium 106	– Bh bohrium 107	– Hs hassium 108	– Mt meitnerium 109	– Unu ununnilium 110	– Uuu ununnium 111	– Uub ununbium 112		– Uuq ununquadium 114		– Uuh ununhexium 116		– Uuo ununoctium 118

Key

relative atomic mass
atomic symbol
name
atomic number

lanthanides *	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	– Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
actinides * *	– Th thorium 90	– Pa protactinium 91	– 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	– Lw lawrencium 103