2012-DSE
CHEM
PAPER 1B

B

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HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2012

Candidate Number									

CHEMISTRY PAPER 1

SECTION B : Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.

(2) Refer to the general instructions on the cover of the Question Paper for Section A.

(3) This section consists of TWO parts, Parts I and II.

(4) Answer ALL questions in both Parts I and II. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) An asterisk (*) has been put next to the questions where one mark will be awarded for effective communication.

(6) Supplementary answer sheets will be provided on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string INSIDE this Question-Answer Book.

(7) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

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PART I

Answer **ALL** questions. Write your answers in the spaces provided.

1. Neon occurs naturally in three isotopes with the abundance of each isotope shown in the table below :

Isotope	Abundance (%)
^{20}Ne	90.48
^{21}Ne	0.27
^{22}Ne	9.25

(a) What is meant by the term 'isotope' ?

(1 mark)

(b) Calculate the relative atomic mass of neon.

(2 marks)

(c) Give one daily application of neon.

(1 mark)

(d) Explain why the boiling point of neon is lower than that of oxygen.

(2 marks)

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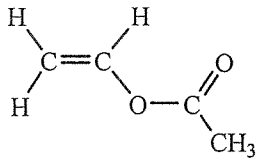
2. Poly(ethenyl ethanoate) is a polymer. Its monomer is ethenyl ethanoate with the structure shown below :



(a) Ethene is the raw material used in making ethenyl ethanoate. Ethene can be produced from hydrocarbons of higher molecular mass by an important industrial process.

(i) Name this industrial process.

(ii) Explain why this process is important.

(2 marks)

(b) Draw the structure of poly(ethenyl ethanoate).

(1 mark)

(c) Ethyl ethanoate is an organic solvent.

(i) Draw the structure of ethyl ethanoate.

(ii) Suggest a chemical test to show how to distinguish between ethenyl ethanoate and ethyl ethanoate.

(3 marks)

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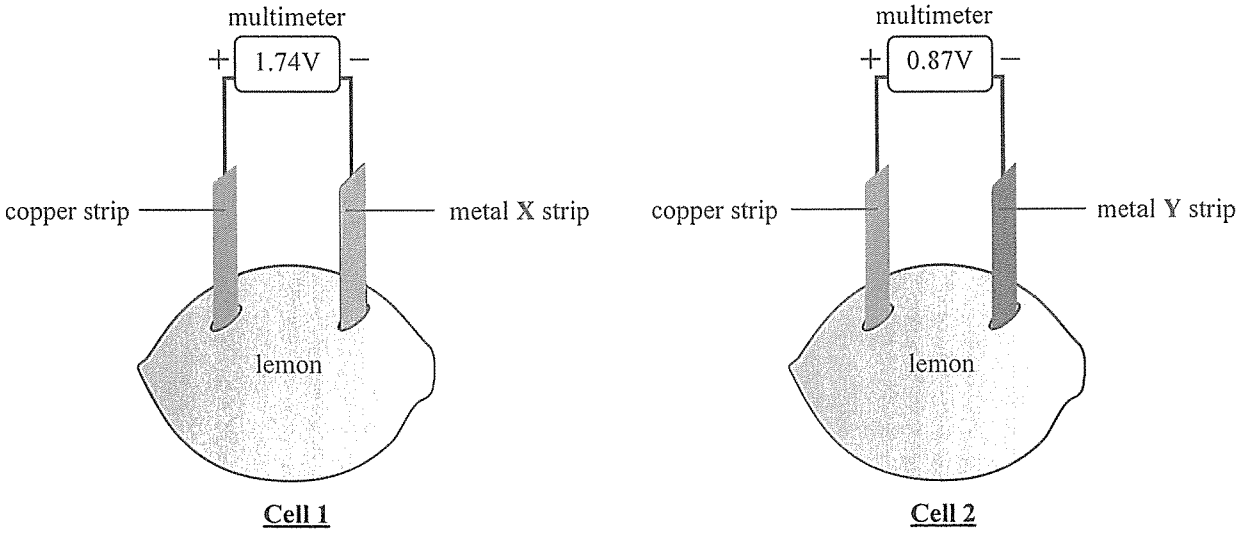
3. Consider the information concerning the lemon cells shown in the diagrams below :



Cell 1 **Cell 2**

(a) What is the function of the lemons in these cells ?

(1 mark)

(b) By completing the table below, arrange metal **X**, metal **Y** and copper in increasing order of reducing power.

Reducing power increasing →		

(1 mark)

(c) For **Cell 1**, write the half equation for the change that occurs at :

(i) metal **X** strip (**X** is a group II metal), and

(ii) copper strip.

(2 marks)

(d) For **Cell 2**, would the metal **Y** strip be the positive electrode if the copper strip is replaced with a silver strip ? Explain your answer.

(1 mark)

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4. With the aid of a diagram, explain the formation of hydrogen bonding in hydrogen fluoride.

(3 marks)

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5. In order to prepare 50 dm^3 of 0.1 M $CuSO_4(aq)$, an inexperienced electroplating worker added the required exact amount of $CuSO_4 \cdot 5H_2O(s)$ to water in a plastic container. He then stirred the mixture with an iron rod until the $CuSO_4 \cdot 5H_2O(s)$ dissolved completely. Finally, he sent a sample of the solution to the Quality Control Laboratory for analysis, but found that the concentration of $CuSO_4(aq)$ was lower than 0.1 M.

(a) With the aid of a chemical equation, explain why the concentration of the $CuSO_4(aq)$ prepared was lower than 0.1 M.

(2 marks)

(b) The worker used the prepared $CuSO_4(aq)$ to coat a layer of copper on a metallic object by electrolysis. He used an unreasonably high voltage, and found that some bubbles were formed on the object and the copper layer easily flaked off.

(i) Explain why copper can be coated on the metallic object by electrolysis.

(ii) Suggest what the bubbles were, and explain why the copper layer easily flaked off.

(3 marks)

(c) Draw a labelled diagram of the experimental set-up used in a laboratory for coating a layer of copper on a metallic object by electrolysis.

(3 marks)

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*6. Outline the steps in preparing solid lead(II) sulphate from solid lead(II) nitrate. You have to state the additional chemical reagents that are required, but need NOT mention the apparatus involved.

(4 marks)

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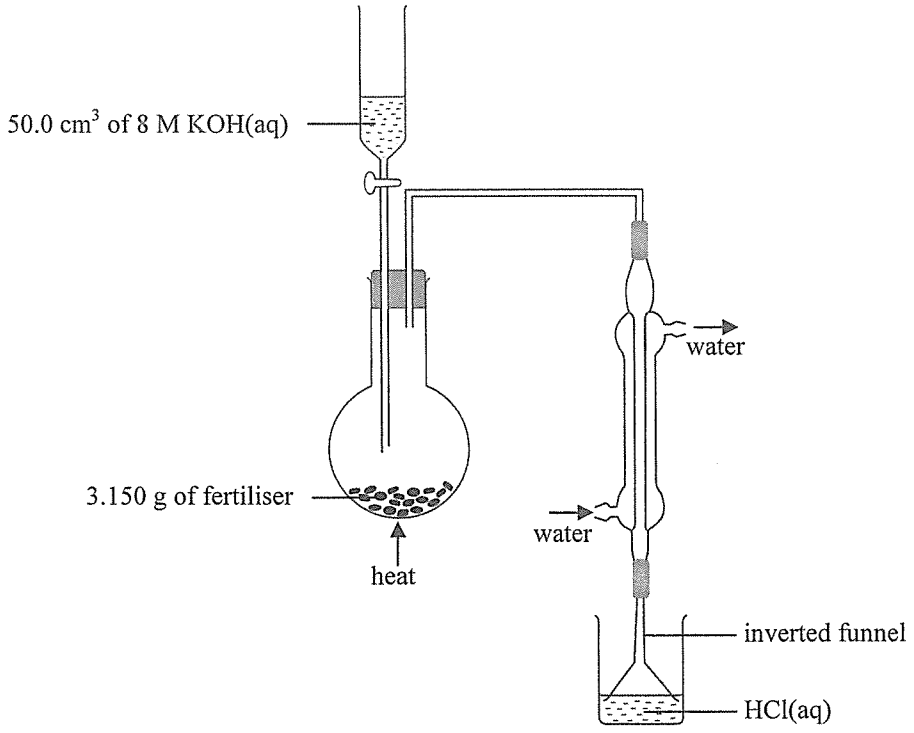
7. A fertiliser only contains ammonium nitrate (NH_4NO_3) and potassium chloride (KCl). An experiment was performed to determine the percentage by mass of NH_4NO_3 in this fertiliser. The set-up used is shown below :



The KOH(aq) was added slowly to the fertiliser and the mixture formed was heated gently. The ammonia liberated from the reaction between NH_4NO_3 and KOH was first cooled in a condenser, and then passed through an inverted funnel to a solution containing 0.0485 mol of HCl. The solution was finally made up to 100.00 cm^3 and labelled '**S**'.

(a) Write an ionic equation for the reaction between NH_4NO_3 and KOH.

(1 mark)

(b) Suggest the potential hazard of one of the chemicals used.

(1 mark)

(c) Given that ammonia is very soluble in water, state the advantage of using an inverted funnel.

(1 mark)

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7. (d) 25.00 cm^3 of 'S' was transferred to a conical flask, and then titrated with 0.100M NaOH(aq) using methyl orange as an indicator. 41.00 cm^3 of the NaOH(aq) was required to reach the end point.

(i) Name the apparatus that should be used to transfer 25.00 cm^3 of 'S'.

(ii) State the colour change at the end point of the titration.

(iii) Calculate the percentage by mass of NH_4NO_3 in this fertiliser.
(Molar mass of NH_4NO_3 = 80.0 g)

(5 marks)

(e) Suggest a test to show the presence of a potassium-containing compound in the fertiliser.

(1 mark)

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8. Potassium hydrogencarbonate ($KHCO_3$) can be used to bake bread. Upon heating, $KHCO_3$ decomposes into K_2CO_3, H_2O and CO_2.

(a) Explain the purpose of using $KHCO_3$ in bread baking.

(1 mark)

(b) Write the chemical equation for the decomposition of $KHCO_3$ upon heating.

(1 mark)

(c) The enthalpy change of decomposition of $KHCO_3(s)$ can be determined indirectly from the enthalpy changes of the following two reactions :

$KHCO_3(s) + HCl(aq) \rightarrow KCl(aq) + H_2O(l) + CO_2(g)$ -------- Reaction (1)

$K_2CO_3(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2O(l) + CO_2(g)$ -------- Reaction (2)

In an experiment to determine the enthalpy change of Reaction (1), 3.39 g of $KHCO_3(s)$ was added to excess HCl(aq) in an expanded polystyrene cup. The experimental data obtained are shown below :

Initial temperature of the reacting solution:	25.8 °C
Final temperature of the reacting solution:	20.2 °C
Mass of the resulting solution:	27.5 g
Specific heat capacity of the contents:	4.3 J g^{-1} K^{-1}
Molar mass of $KHCO_3$:	100.1 g

(i) Assuming that the heat capacity of the cup used is negligible, calculate the enthalpy change of Reaction (1) from the above data.

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8. (c) (ii) In another experiment performed under the same conditions, the enthalpy change of Reaction (2) was found to be -49.1 kJ mol^{-1}. Calculate the enthalpy change of decomposition of $KHCO_3(s)$ under the experimental conditions.

(4 marks)

(d) According to the literature, the standard enthalpy changes of formation of $K_2CO_3(s)$, $KHCO_3(s)$, $CO_2(g)$ and $H_2O(l)$ are as follows :

Compound	$\Delta H_f^{\ominus}$, 298 / kJ mol^{-1}
$K_2CO_3(s)$	−1146
$KHCO_3(s)$	−959
$CO_2(g)$	−394
$H_2O(l)$	−286

(i) Using the given information, calculate the standard enthalpy change of decomposition of $KHCO_3(s)$.

(ii) Suggest why the answers obtained from (c)(ii) and (d)(i) are different.

(2 marks)

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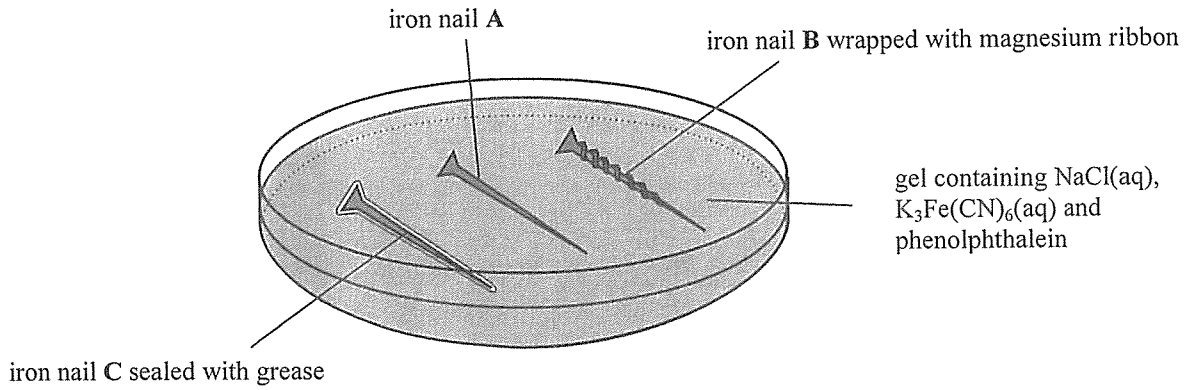
9. The diagram below shows an experimental set-up for investigating the factors affecting rusting.



(a) What would be observed if an iron nail in the above set-up rusts ?

(1 mark)

(b) Suggest which of the iron nails in the above set-up would NOT rust during the experiment. Explain your answer.

(3 marks)

10. Suggest THREE measures for reducing the emission of air pollutants upon using fossil fuels.

(3 marks)

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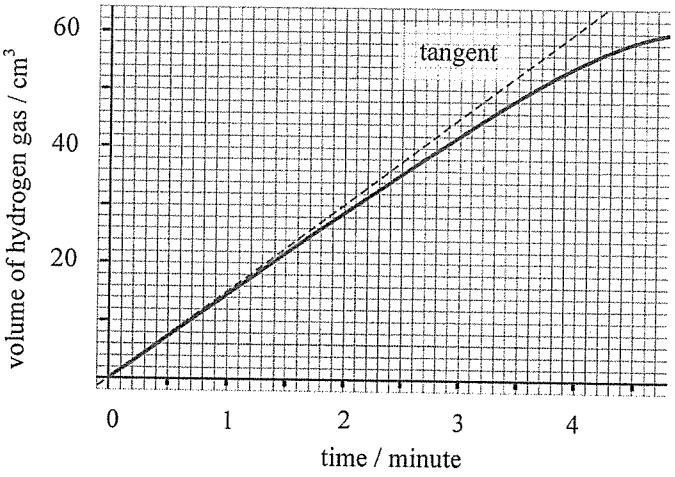
PART II

Answer **ALL** questions. Write your answers in the spaces provided.

11. In an experiment, 50 cm^3 of 2.0 M HCl(aq) was added to a conical flask containing 2.0 g of zinc powder. The curve in the graph below shows the volume, measured at room temperature and pressure, of the hydrogen gas liberated in the first few minutes of the experiment. The dotted line in the graph is the tangent to the curve at the start of the reaction.



(a) The 'initial rate' of a reaction is defined as the instantaneous rate at the start of the reaction. With reference to the graph above, calculate the initial rate of the reaction with respect to the volume of hydrogen gas liberated.

(1 mark)

(b) Explain qualitatively the effect on the initial rate of the reaction of replacing the 2.0 M HCl(aq) with 2.0 M H_2SO_4(aq).

(1 mark)

(c) Upon completion of the reaction, all the zinc powder was used up. Calculate the theoretical volume of hydrogen gas liberated, measured at room temperature and pressure.
(Molar volume of gas at room temperature and pressure = 24 dm^3;
Relative atomic mass: Zn = 65.4)

(3 marks)

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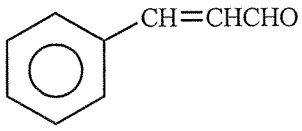
12. Cinnamon, which can be used as a flavouring, contains cinnamaldehyde (C_9H_8O). The structure of cinnamaldehyde is shown below :



(a) Draw the *trans*-isomer for the above structure.

(1 mark)

(b) Explain why ethyl ethanoate is a better solvent than water for dissolving cinnamaldehyde.

(1 mark)

(c) In an experiment to extract cinnamaldehyde from cinnamon, a solution containing only ethyl ethanoate and cinnamaldehyde is obtained after a series of steps. In order to separate these two compounds, simple distillation can be carried out. Draw a diagram for the set-up involved, and label the name of the distillate collected.
(Boiling points: cinnamaldehyde = 248 °C, ethyl ethanoate = 77 °C)

(2 marks)

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12. (d) Outline a synthetic route, with *no more than three steps*, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.

(2 marks)

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13. Consider the reaction represented by the equation below :

$Fe^{3+}(aq) + SCN^{-}(aq) \rightleftharpoons Fe(SCN)^{2+}(aq)$

In an experiment, 25.0 cm^3 of 0.010 M $Fe_2(SO_4)_3(aq)$ and 25.0 cm^3 of 0.010 M KSCN(aq) were mixed in a conical flask at room temperature, and equilibrium was attained.

(a) The concentration of $Fe(SCN)^{2+}(aq)$ in the mixture was 0.0043 M when equilibrium was attained. Calculate the equilibrium constant K_c for the above reaction at room temperature.

(3 marks)

(b) It is known that $FePO_4(s)$ is insoluble in water. Suggest what would be the effect on the equilibrium position if $Na_3PO_4(s)$ is added to the equilibrium mixture.

(1 mark)

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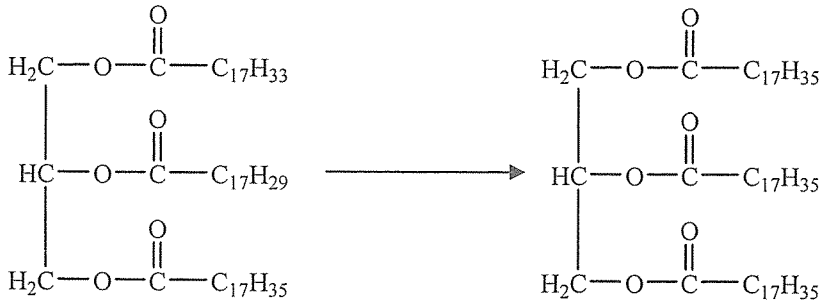
14. The diagram below shows the conversion of an oil molecule **X** to a fat molecule **Y**.



X **Y**

(a) (i) Given that all alkyl groups in both **X** and **Y** are straight chains, label the chiral carbon(s) by using '*' in the above diagram.

(ii) With reference to (i), explain whether a change in optical activity is involved in the above conversion.

(2 marks)

*(b) One of the products in the alkaline hydrolysis of **Y** has a cleansing property. Explain the cleansing property of this product.

(4 marks)

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15. Use electron diagrams to illustrate, step by step, how CH_4 reacts with Br_2 under sunlight to form CH_3Br. (Show electrons in the *outermost shells* only.)

(3 marks)

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16. Consider the following oxides :

Na_2O MgO Al_2O_3 SiO_2 P_4O_{10} SO_2 Cl_2O

(a) Which of the oxides listed above can conduct electricity in molten state ?

(1 mark)

(b) Explain why SiO_2 has the highest melting point among the covalent oxides listed above.

(2 marks)

(c) Write a chemical equation for the reaction between $Al_2O_3(s)$ and NaOH(aq).

(1 mark)

END OF SECTION B

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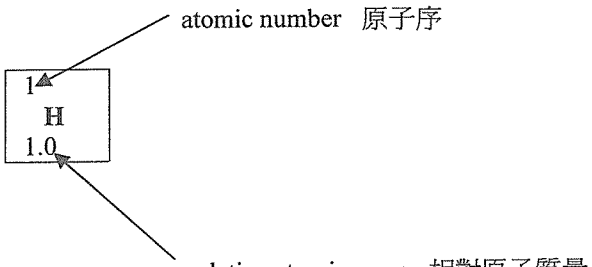
PERIODIC TABLE 周期表

GROUP 族



I	II											III	IV	V	VI	VII	0
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 * **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 ** **Ac** (227)	104 **Rf** (261)	105 **Db** (262)													

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
**	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)