HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2020

CHEMISTRY PAPER 1

8:30 am – 11:00 am (2 hours 30 minutes)

This paper must be answered in English

GENERAL INSTRUCTIONS

1. There are **TWO** sections, A and B, in this Paper. You are advised to finish Section A in about 45 minutes.

2. Section A consists of multiple-choice questions in this question paper, while Section B contains conventional questions printed separately in Question-Answer Book **B**.

3. Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book **B**. **The Answer Sheet for Section A and the Question-Answer Book for Section B will be collected separately at the end of the examination.**

4. A Periodic Table is printed on page 20 of Question-Answer Book **B**. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.

INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)

1. Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first stick a barcode label and insert the information required in the spaces provided. No extra time will be given for sticking on the barcode label after the 'Time is up' announcement.

2. When told to open this book, you should check that all the questions are there. Look for the words **'END OF SECTION A'** after the last question.

3. All questions carry equal marks.

4. **ANSWER ALL QUESTIONS.** You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.

5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

6. No marks will be deducted for wrong answers.

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Not to be taken away before the end of the examination session

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This section consists of two parts. There are 24 questions in PART I and 12 questions in PART II.

Choose the best answer for each question.

Candidates may refer to the Periodic Table printed on page 20 of Question-Answer Book B.

PART I

1. Which of the following statements concerning quicklime is INCORRECT ?

   A. Heating marble strongly can form quicklime.
   B. Reacting quicklime with sulphur dioxide can form calcium sulphate.
   C. Reacting quicklime with carbon dioxide can form calcium carbonate.
   D. A large amount of heat evolves when quicklime is put into water.

2. Which of the following statements concerning quartz is correct ?

   A. Quartz is soluble in hexane.
   B. Quartz consists of SiO_2 molecules.
   C. Quartz conducts electricity by delocalised electrons.
   D. Quartz is hard because it has a giant covalent network structure.

3. What is the mass of oxygen in 24.0 g of $CuSO_4 \cdot 5H_2O(s)$?

   (Relative atomic masses : H = 1.0, O =16.0, S = 32.1, Cu = 63.5)

   A. 6.2 g
   B. 9.6 g
   C. 13.8 g
   D. 21.7 g

4. Which of the following combinations would give a brown gas when putting **X** in **Y** ?

	X	**Y**
A.	magnesium	concentrated nitric acid
B.	magnesium	concentrated sulphuric acid
C.	magnesium oxide	concentrated sulphuric acid
D.	magnesium oxide	concentrated nitric acid

5. Which of the following statements concerning francium (atomic number = 87) is correct ?

   A. Francium has a higher melting point than potassium.
   B. Francium forms cations more readily than potassium.
   C. Francium is a weaker oxidising agent than potassium.
   D. Francium has a fewer number of occupied electron shells than potassium.

6. What is the product of the reaction between chloroethene and bromine dissolved in an organic solvent ?

   A. 2-chloro-1,2-dibromoethane
   B. 1,2-dibromo-1-chloroethane
   C. 2-chloro-1,1-dibromoethane
   D. 2,2-dibromo-1-chloroethane

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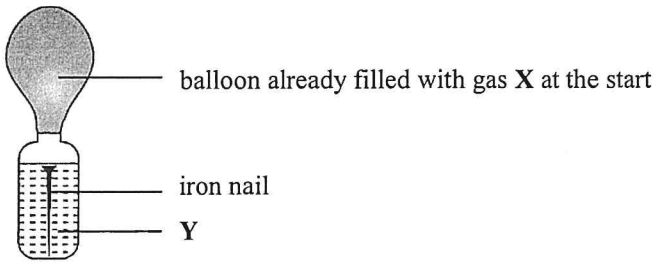
7. Refer to the information in the table below :

Material	Rank order of Hardness (1 = hardest)	Density / g cm^{-3}	Rank order of Price (1 = cheapest)
P	4	8.9	4
Q	3	7.8	1
R	2	10.5	3
S	1	2.7	2

Which is the best material to make aircraft body ?

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

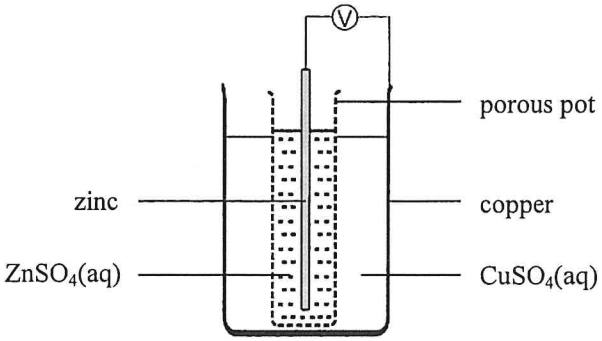
8. Consider the following experimental set-up :



In which of the following combinations would the iron nail rust the fastest ?

	X	**Y**
A.	hydrogen	petrol
B.	hydrogen	distilled water
C.	oxygen	petrol
D.	oxygen	distilled water

9. Refer to the following chemical cell :



Which of the following statements is correct ?

A. Copper is the cathode of the cell.
B. Zinc ions act as the oxidising agent in the cell.
C. Only zinc ions can pass through the porous pot.
D. Electrons flow from copper to zinc through the external circuit.

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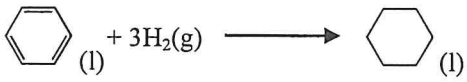
10. Refer to the standard enthalpy changes of combustion below :


(l)
-3268 kJ mol^{-1}


(l)
-3920 kJ mol^{-1}

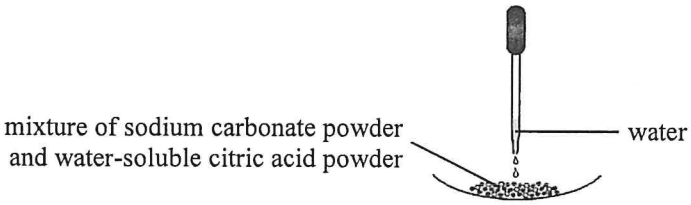
$H_2(g)$
-286 kJ mol^{-1}

What is the standard enthalpy change of the following reaction ?



A. -206 kJ mol^{-1}
B. -652 kJ mol^{-1}
C. $+206$ kJ mol^{-1}
D. $+652$ kJ mol^{-1}

11. A reaction occurs when water is dropped into the mixture in the set-up below. A colourless gas is given out.



What is the role of water in this reaction ?

A. Water reacts with sodium carbonate to give the colourless gas.
B. Water reacts with citric acid to give the colourless gas.
C. Water is a medium for the formation of carbonate ions from sodium carbonate.
D. Water is a medium for the formation of hydrogen ions from citric acid.

12. Refer to the following half equations :

$C_2O_4^{2-}(aq) \rightarrow 2CO_2(g) + 2e^-$
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$

What is the minimum volume of 0.010 M acidified $KMnO_4(aq)$ required to completely oxidise 15.00 cm^3 of 0.020 M $Na_2C_2O_4(aq)$?

A. 6.00 cm^3
B. 12.00 cm^3
C. 15.00 cm^3
D. 75.00 cm^3

13. The enthalpy changes for some conversions are shown below :

$$\mathbf{W} \xrightarrow{\Delta H = -150 \text{ kJ mol}^{-1}} \mathbf{X} \xrightarrow{\Delta H = +100 \text{ kJ mol}^{-1}} \mathbf{Y} \xrightarrow{\Delta H = +60 \text{ kJ mol}^{-1}} \mathbf{Z}$$

Which of the following combinations is correct ?

	W ⟶ Z	**Z ⟶ X**
A.	exothermic	endothermic
B.	exothermic	exothermic
C.	endothermic	exothermic
D.	endothermic	endothermic

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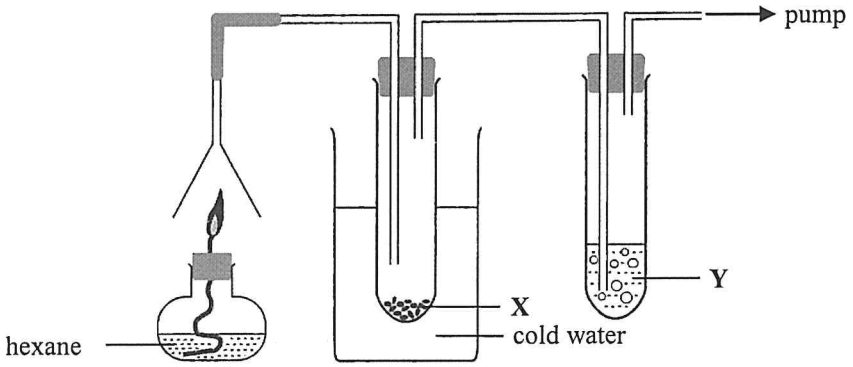
14. The set-up below is used to show that hexane (C_6H_{14}) contains carbon and hydrogen. What are **X** and **Y** ?



	X	Y
A.	$PbSO_4(s)$	limewater
B.	$NaOH(s)$	bromine water
C.	anhydrous $CoCl_2(s)$	limewater
D.	anhydrous $CuSO_4(s)$	bromine water

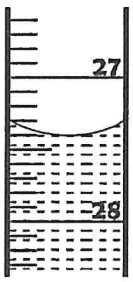
15. The observations of heating three metal carbonates are shown below :

Metal carbonate	Observation
$\mathbf{X}_2CO_3$	A gas was given out and a shiny silvery solid was formed.
$\mathbf{Y}_2CO_3$	There was no observable change.
$\mathbf{Z}CO_3$	A gas was given out and a yellow solid was formed.

Which of the following shows the decreasing order of reactivity of the metals ?

A. **Z > Y > X**
B. **Y > X > Z**
C. **Z > X > Y**
D. **Y > Z > X**

16. The initial burette reading in a titration is 4.80 cm^3, and the corresponding final burette reading can be found from the diagram below :



What is the volume of the reagent used in the titration ?

A. 23.90 cm^3
B. 23.80 cm^3
C. 22.60 cm^3
D. 22.50 cm^3

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17. Which of the following ways is / are acceptable in the storage of the chemical concerned ?

(1) Store concentrated $H_2SO_4(l)$ in a copper container.
(2) Store concentrated $AgNO_3(aq)$ in a brown glass container.
(3) Store concentrated $Pb(NO_3)_2(aq)$ in an iron container.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

18. Which of the following steps can be involved in preparing copper(II) chloride crystals ?

(1) Add $CuCO_3(s)$ to $HCl(aq)$.
(2) Add $Cu(NO_3)_2(s)$ to $NaCl(aq)$.
(3) Add $Cu(s)$ to $HCl(aq)$.

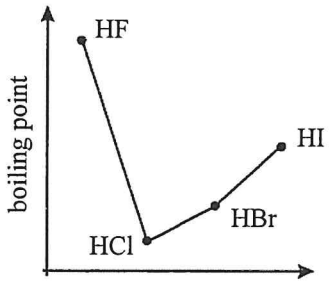
A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

19. Which of the following processes can form a halogen ?

(1) Electrolyse concentrated $KCl(aq)$.
(2) Add $Na_2SO_4(s)$ to concentrated $HBr(aq)$.
(3) Add $KI(s)$ to acidified $KMnO_4(aq)$.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

20. Refer to the sketch below :



Which of the following can explain the variation of the boiling points of the hydrogen halides ?

(1) The boiling point of HF is higher than that of HCl because the hydrogen bonds between HF molecules are stronger than the van der Waals' forces between HCl molecules.
(2) The boiling point of HI is higher than that of HBr because HI molecules are more polar than HBr molecules.
(3) HCl has the lowest boiling point because it has the smallest molecular size.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

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21. Which of the following statements are correct ?

(1) The standard enthalpy change of formation of $NH_3(g)$ can be determined directly from experiment.
(2) The standard enthalpy change of combustion of $H_2NNH_2(l)$ is negative.
(3) The standard enthalpy change of formation of $N_2(g)$ is zero.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

22. Which of the following statements concerning ice and water at 0 °C are correct ?

(1) The density of ice is lower than that of water because ice has an open structure but water does not.
(2) In ice, the hydrogen bonds between the molecules are weaker than the covalent bonds in the molecules.
(3) In ice, each molecule links up with only two neighbouring molecules by hydrogen bonds.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

23. Which of the following hazard warning labels should be displayed on a bottle containing methanol ?


(1)


(2)


(3)

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

24. Consider the following statements and choose the best answer :

1st statement	**2nd statement**
Perspex can be used to make shopping bags.	Perspex is a condensation polymer.

A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
C. The 1st statement is false but the 2nd statement is true.
D. Both statements are false.

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PART II

25. Consider the following reaction :

$$4H_2(g) + Fe_3O_4(s) \rightarrow 3Fe(s) + 4H_2O(l)$$

What is the minimum volume of $H_2(g)$ at room conditions required to form 0.168 g of Fe(s) ?

(Molar volume of gas at room conditions = 24 dm^3;
Relative atomic mass : Fe = 55.8)

A. 24 cm^3
B. 48 cm^3
C. 96 cm^3
D. 192 cm^3

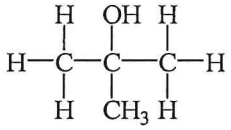
26. Consider the information below :

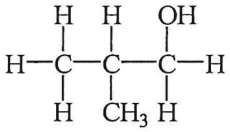
Reaction	**Equilibrium constant at 25 °C**
$H_2A(aq) \rightleftharpoons H^+(aq) + HA^-(aq)$	1.3×10^{-3} mol dm^{-3}
$HA^-(aq) \rightleftharpoons H^+(aq) + A^{2-}(aq)$	3.1×10^{-6} mol dm^{-3}
$2HA^-(aq) \rightleftharpoons H_2A(aq) + A^{2-}(aq)$	**X**

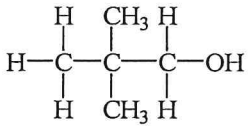
What is the numerical value of **X** ?

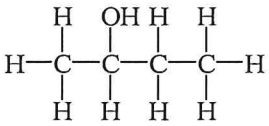
A. 4.2×10^2
B. 2.4×10^{-3}
C. 4.0×10^{-9}
D. 2.5×10^8

27. Which of the following alkanols can form a ketone by warming with acidified sodium dichromate solution ?

A.


B.


C.


D.


28. Which of the following statements concerning the oxides of elements in the third period of the Periodic Table is correct ?

A. $SiO_2(s)$ dissolves in water to form a neutral solution.
B. $P_4O_{10}(s)$ dissolves in water to form an acidic solution.
C. $Al_2O_3(s)$ dissolves in water to form an alkaline solution.
D. $Cl_2O(g)$ dissolves in water to form $Cl_2(aq)$ and $O_2(g)$ only.

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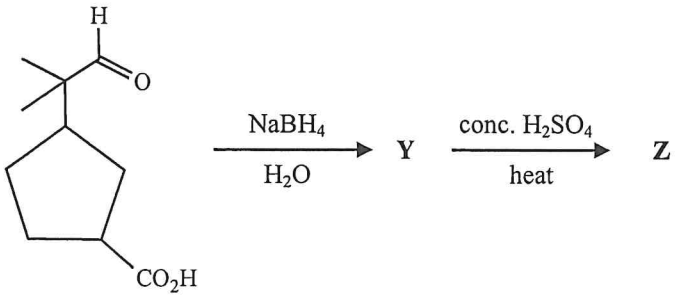
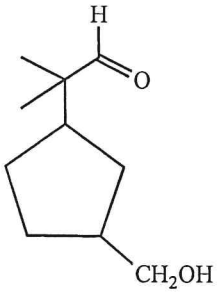
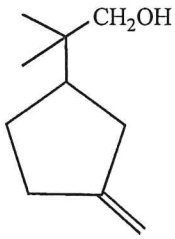
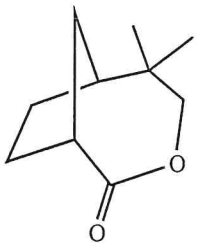
29. Refer to the following conversions :

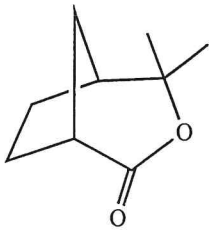


Which of the following is a possible structure of **Z** ?

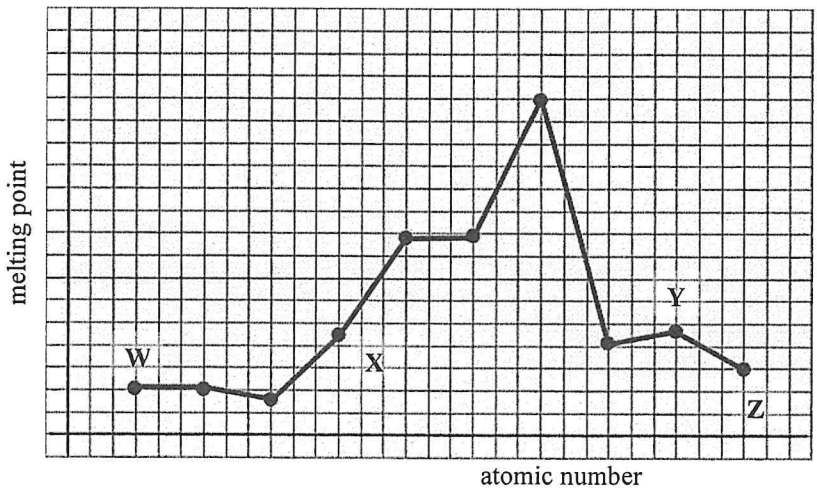
A.


B.


C.


D.


30. The sketch below shows the melting points of ten consecutive elements in the second and third periods of the Periodic Table, arranged in the order of increasing atomic numbers. Sodium is one of these ten elements. Which of **W**, **X**, **Y** or **Z** may represent sodium ?



A. **W**
B. **X**
C. **Y**
D. **Z**

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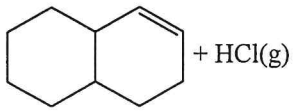
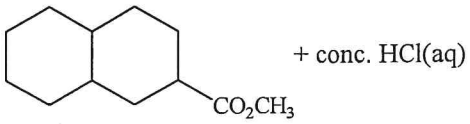
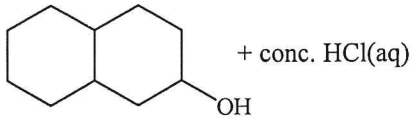
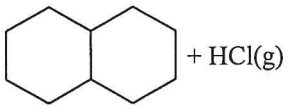
31. Which of the following pairs of reagents would NOT react with each other ?

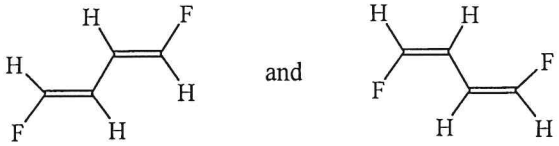
A. 

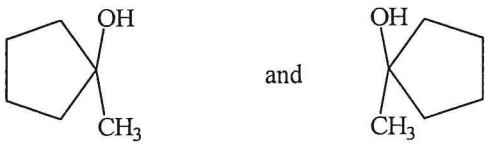
B. 

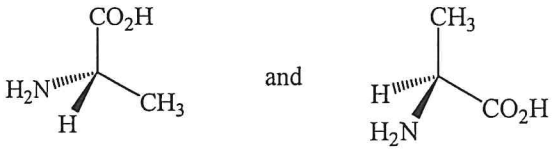
C. 

D. 

32. Which of the following pairs of compounds are isomers ?

(1) 

(2) 

(3) 

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

33. Refer to the following chemical reaction :

$$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq) \qquad \Delta H > 0$$

The pH of a pure water sample is 7.0 at 25 °C. Which of the following statements is / are correct when the sample has been heated to 50 °C ?

(1) The $[OH^-(aq)]$ of the sample is 1.0×10^{-7} mol dm^{-3}.
(2) The pH of the sample is smaller than 7.0.
(3) The sample remains neutral.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

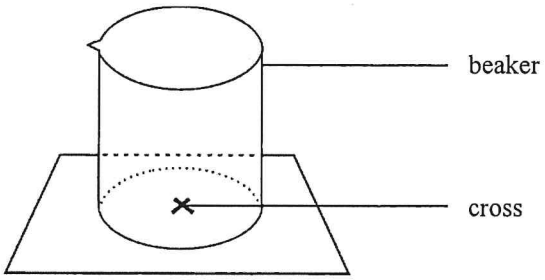
Provided by dse.life

34. Which of the following statements concerning nylon-6,6 are correct ?

(1) Fishing net can be made from nylon-6,6.
(2) $H_2N(CH_2)_6NH_2$ is one of the monomers of nylon-6,6.
(3) The intermolecular attractions in nylon-6,6 are covalent bonds.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

35. Refer to the following set-up :



Which of the following reactions can the effect of concentration on rate be studied by the above set-up ?

(1) $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$
(2) $Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow S(s) + SO_2(g) + H_2O(l) + 2NaCl(aq)$
(3) $Mg(s) + ZnSO_4(aq) \rightarrow MgSO_4(aq) + Zn(s)$

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

36. Consider the following statements and choose the best answer :

1st statement	**2nd statement**
The rate of conversion from glucose to ethanol is increased by adding yeast.	The conversion from glucose to ethanol is catalysed by enzymes in yeast.

A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
C. The 1st statement is false but the 2nd statement is true.
D. Both statements are false.

END OF SECTION A

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2020-DSE
CHEM
PAPER 1B

B

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HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2020

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. The table below shows some information of elements **Y** and **Z**.

	Y	**Z**
Atomic number	35	53
Number of occupied electron shells in the atoms	4	5
Number of electrons in the outermost shell in the atoms	7	7

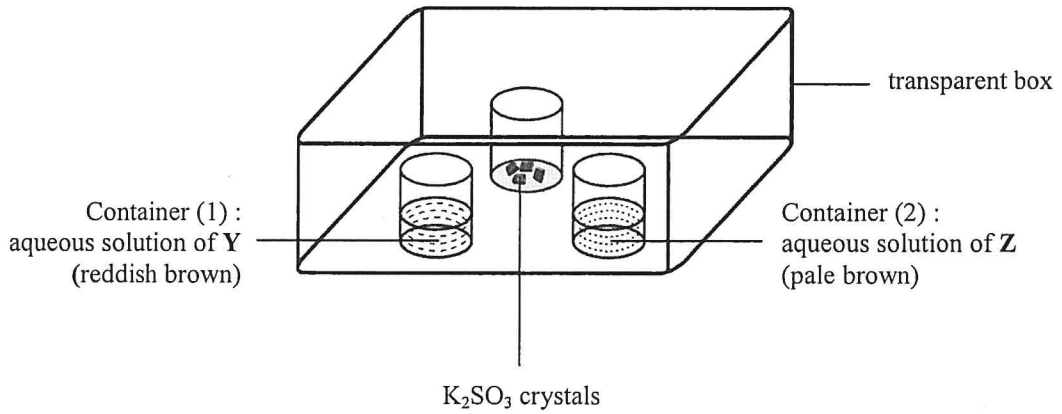
(a) State the electronic arrangement of an atom of **Y**.

(1 mark)

(b) Draw the electron diagram for a molecule of **Z**, showing ELECTRONS IN THE OUTERMOST SHELLS only.

(1 mark)

(c) An experiment for **Y** and **Z** is performed as shown in the set-up below. Dilute hydrochloric acid is added to the K_2SO_3 crystals, then the whole set-up is covered with a lid.



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1. (c) (i) K_2SO_3 crystals react with dilute hydrochloric acid to give sulphur dioxide gas. Write a chemical equation for the reaction, showing all state symbols.

(ii) State the expected observation in Container (1) and write an ionic equation for the reaction involved.

(iii) It is expected that the observation in Container (2) is similar to that in Container (1). Suggest a reason for this expectation based on electronic arrangement.

(5 marks)

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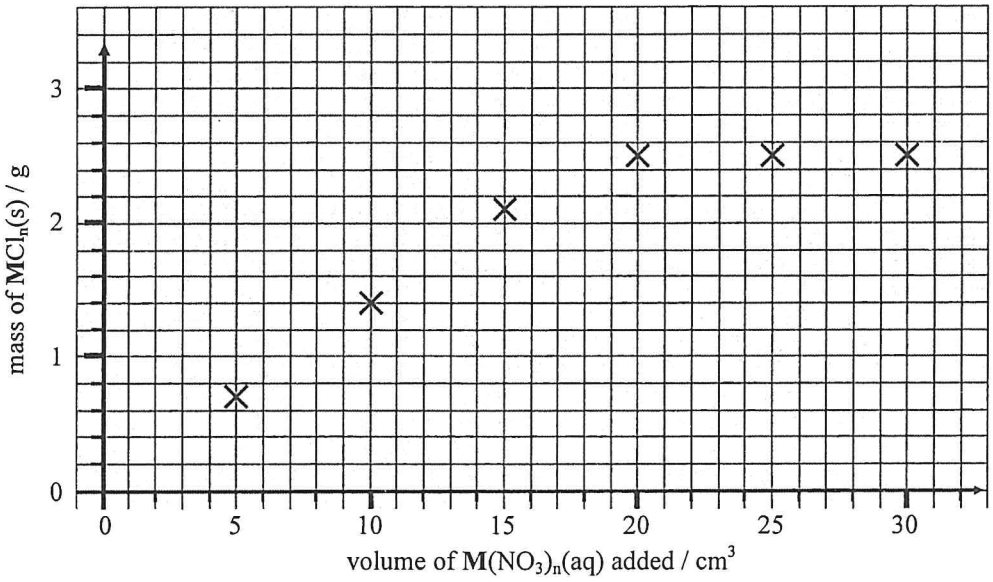
2. An experiment was performed to deduce the empirical formula of an insoluble chloride of a metal **M**. At room temperature, different volumes of a 0.50 mol dm^{-3} $\mathbf{M}(NO_3)_n(aq)$ were added to six beakers each containing 50 cm^3 of 0.36 mol dm^{-3} HCl(aq). The $\mathbf{MCl}_n(s)$ obtained in each beaker was filtered, washed, dried and weighed. The mass of $\mathbf{MCl}_n(s)$ obtained and the corresponding volume of $\mathbf{M}(NO_3)_n(aq)$ added were plotted on the graph below.



(a) Suggest why the masses of $\mathbf{MCl}_n(s)$ for the last three points in the graph are the same.

(1 mark)

(b) (i) By **sketching** on the graph above, deduce the volume of the $\mathbf{M}(NO_3)_n(aq)$ that can completely react with 50 cm^3 of 0.36 mol dm^{-3} HCl(aq).

Volume of $\mathbf{M}(NO_3)_n(aq)$ = _____ cm^3

(ii) Hence, calculate the number of moles of $\mathbf{M}(NO_3)_n(aq)$ that can completely react with the HCl(aq).

(3 marks)

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2. (c) Determine, by calculation, the empirical formula of the chloride of **M**. Hence, deduce whether **M** would be silver or lead.

(3 marks)

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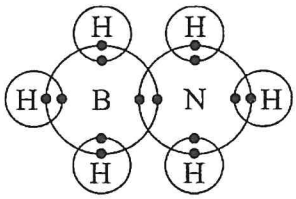
3. (a) Draw a three-dimensional diagram to represent the shape of each of the following molecules :

(i) NH_3

(ii) BH_3

(2 marks)

(b) H_3NBH_3 has a structure similar to that of ethane. Its electron diagram is shown below (showing electrons in the outermost shells only).



(i) Which of the H–B, B–N and N–H bonds would be dative covalent bond(s) ? Explain your answer.

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Answers written in the margins will not be marked.

3. (b) (ii) Explain why H_3NBH_3 is a solid but ethane is a gas at room conditions.

(iii) Under suitable conditions, H_3NBH_3 can decompose into boron nitride and hydrogen. The structure of solid boron nitride is similar to that of graphite. Draw the structure of ONE LAYER of solid boron nitride (Note : B and N are in alternate positions).

(6 marks)

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4. Eggshells mainly contain calcium carbonate and a small amount of organic substances. The percentage by mass of calcium carbonate in a sample of eggshell was determined by the following steps :

Step (1) : The sample was ground into powder.
Step (2) : 0.204 g of the powder was put into a conical flask. After that, 25.00 cm^3 of 0.200 M HCl(aq) and 5 cm^3 of ethanol were added.
Step (3) : The mixture was heated for 15 minutes.
Step (4) : After cooling down, the mixture was titrated with 0.102 M NaOH(aq) using an indicator **X**.

(a) Explain why the sample was ground into powder in Step (1).

(1 mark)

(b) Suggest why ethanol was added in Step (2).

(1 mark)

(c) Suggest why the mixture was heated for 15 minutes in Step (3).

(1 mark)

(d) The mixture turned from colourless to pale pink at the end point of titration in Step (4). Name indicator **X**.

(1 mark)

(e) 16.85 cm^3 of NaOH(aq) was needed to reach the end point of titration in Step (4). Calculate the percentage by mass of calcium carbonate in the sample.
(Relative atomic masses : C = 12.0, O = 16.0, Ca = 40.1)

(3 marks)

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5. The molecular formula of an organic compound **W** is $C_4H_6O_4$. It is soluble in water.

(a) When a piece of magnesium ribbon is placed into an aqueous solution of **W**, hydrogen gas evolves. According to this observation, suggest a functional group that **W** may contain.

(1 mark)

(b) It is known that one mole of **W** can completely react with two moles of NaOH.

(i) Draw TWO possible structures of **W**.

(ii) Consider the following thermochemical equation of a neutralisation reaction in standard conditions :

$$C_4H_6O_4(aq) + 2NaOH(aq) \rightarrow Na_2C_4H_4O_4(aq) + 2H_2O(l) \quad \Delta H^{\ominus} = \mathbf{y}\ kJ\ mol^{-1}$$

State the meaning of the term 'standard enthalpy change of neutralisation', and deduce the standard enthalpy change of neutralisation for this reaction in terms of **y**.

(iii) The standard enthalpy change of neutralisation between HCl(aq) and NaOH(aq) is $-57.3\ kJ\ mol^{-1}$. Explain whether the enthalpy change deduced in (ii) above should be more negative than, less negative than or equal to $-57.3\ kJ\ mol^{-1}$.

(6 marks)

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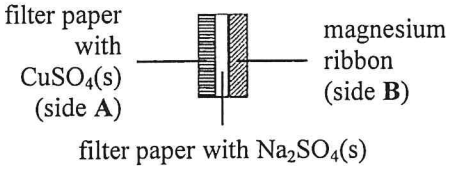
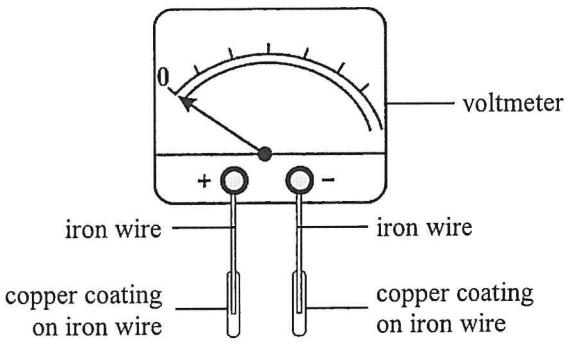
6. The diagrams below show the component of a chemical cell, an experimental set-up and how the pointer of the voltmeter deflects when the set-up is connected to the component.

component of a chemical cell



experimental set-up



The pointer of the voltmeter deflects to a positive reading when a few drops of water are added to the component

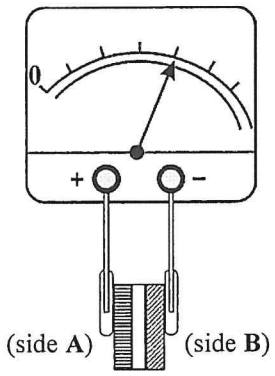


Diagram (1)

(a) Why does the pointer of the voltmeter deflect as shown when a few drops of water are added to the component ?

(2 marks)

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6. (b) Write the half equation for the change that occurs at each of the following electrodes when the pointer of the voltmeter deflects :

(i) anode

(ii) cathode

(2 marks)

(c) Consider the following design modified from **Diagram (1)** by only removing the copper coating at side **A** :

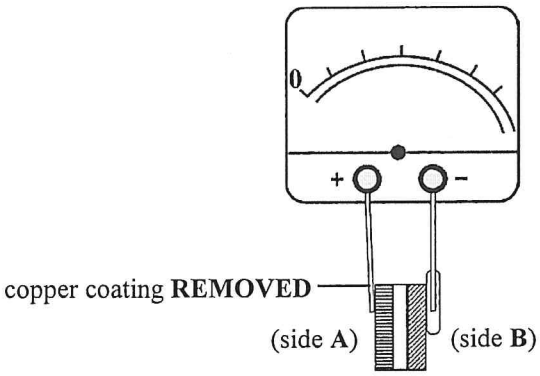

Diagram (2)

Draw on **Diagram (2)** the expected position of the pointer of the voltmeter when water is added to the component.

(1 mark)

(d) In the design in part (c) above, a redox reaction occurs at side **A** when water is added to the component.

(i) Write a chemical equation for the reaction.

(ii) Name this type of reaction.

(2 marks)

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7. An experiment is performed to study the following reaction :

$Ba(OH)_2 \cdot 8H_2O(s) + 2NH_4Cl(s) \rightarrow BaCl_2(s) + 10H_2O(l) + 2NH_3(g)$

(a) When the two solid reactants are mixed and stirred in a conical flask, ammonia gas with a characteristic pungent smell is formed. Explain how ammonia gas can be tested.

(2 marks)

(b) $Ba(OH)_2 \cdot 8H_2O(s)$ is an alkali. What is meant by the term 'alkali' ?

(1 mark)

(c) The standard enthalpy change of formation of $Ba(OH)_2 \cdot 8H_2O(s)$ is -3345 kJ mol^{-1}.

(i) Write a thermochemical equation for the standard enthalpy change of formation of $Ba(OH)_2 \cdot 8H_2O(s)$.

(ii) Calculate the standard enthalpy change of the reaction between $Ba(OH)_2 \cdot 8H_2O(s)$ and $NH_4Cl(s)$.
(Standard enthalpy changes of formation :
$NH_3(g) = -46$ kJ mol^{-1}, $H_2O(l) = -286$ kJ mol^{-1}, $NH_4Cl(s) = -314$ kJ mol^{-1},
$BaCl_2(s) = -859$ kJ mol^{-1})

(iii) Hence, explain whether the temperature of the mixture would increase, decrease or remain unchanged during the reaction.

(4 marks)

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*8. Describe how 1,2-dibromoethane can be produced from crude oil, via an alkene, using appropriate chemicals and processes. Write the chemical equations for the reactions involved.

(6 marks)

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PART II

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

9. Consider the following reaction mixture at 25°C in a closed container of fixed volume :

$$\underset{\text{brown}}{2NO_2(g)} \rightleftharpoons \underset{\text{colourless}}{N_2O_4(g)}$$

(a) With reference to the table below, calculate **a**. Hence, determine the equilibrium constant K_c for the reaction at 25°C.

	$NO_2(g)$	$N_2O_4(g)$
Concentration at start / mol dm^{-3}	0.0400	0.0010
Concentration at equilibrium / mol dm^{-3}	0.0323	**a**

(3 marks)

(b) The temperature of the mixture is increased to 55 °C and its colour eventually turns darker. Deduce whether the reaction above is endothermic or exothermic.

(2 marks)

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10. The structure of a compound **Y** is shown below :

$$H_2C{=}CHCH_2OH$$

(a) **Y** can be prepared from reacting 3-chloropropene with an appropriate reagent.

(i) Write a chemical equation for this reaction.

(ii) Name this type of reaction.

(2 marks)

(b) On heating under reflux, a compound **L** reacts with KOH(aq) to give **Y** and $CH_3COO^-K^+$.

(i) Suggest the structural formula of **L**.

(ii) Draw a labelled diagram to show the set-up for this reaction.

(3 marks)

(c) Under suitable conditions, **Y** can form a polymer. Write the repeating unit of the polymer.

(1 mark)

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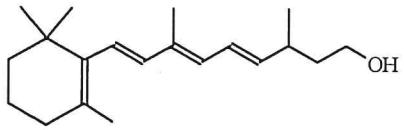
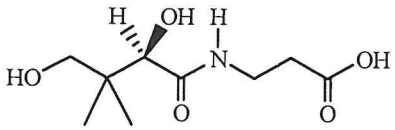
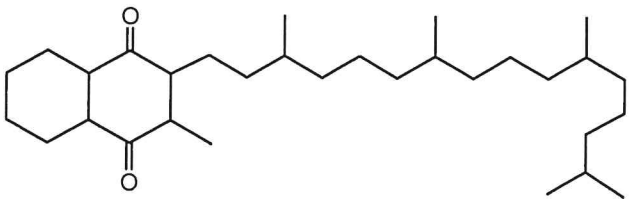
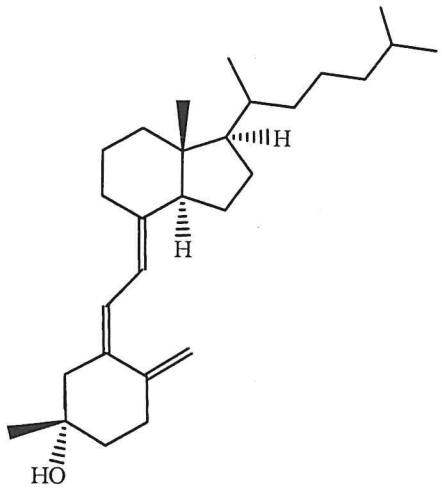
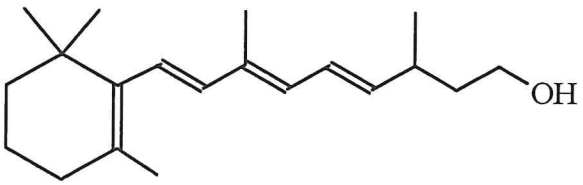
11. The structures of some compounds are shown below :

Compound	Structure
W	
X	
Y	
Z	

(a) Which one of **W**, **X**, **Y** or **Z** is a tertiary alcohol ?

(1 mark)

(b) Label all chiral centre(s), if any, by using '*' on the structure of **W** below.



(1 mark)

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11. (c) Heating **X** under reflux in 2 M NaOH(aq) can form an **optically active** organic compound **U** and an **optically inactive** organic compound **V**. Draw the respective structures of **U** and **V**.

U :

V :

(2 marks)

(d) Consider the following reagents :

$Br_2(aq)$ acidified $K_2Cr_2O_7(aq)$ $Na_2CO_3(aq)$

(i) Suggest which one of the reagents can be used to perform a chemical test, in order to distinguish **X** from **W**, **Y** and **Z**.

(ii) State the observation in the test involved in (i). Explain your answer.

(3 marks)

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12. An experiment was performed to study the following reaction :

$KO_2CCH(OH)CH(OH)CO_2Na(aq) + 3H_2O_2(aq) \rightarrow HCO_2K(aq) + HCO_2Na(aq) + 2CO_2(g) + 4H_2O(l)$
(colourless)

When 10 cm^3 of 0.25 M $KO_2CCH(OH)CH(OH)CO_2Na(aq)$ and 3 cm^3 of 6% $H_2O_2(aq)$ were mixed at 60°C, it was found that only a few gas bubbles evolved. Then a small amount of pink $CoCl_2(aq)$ solution was added to the mixture. Gas bubbles formed vigorously and the mixture turned to green due to the formation of a cobalt(III) compound. When no more gas evolved, the green mixture turned back to pink.

There is a view saying that cobalt illustrates THREE characteristics of transition metals according to the observation of this experiment. Suggest reasons to support this view.

(4 marks)

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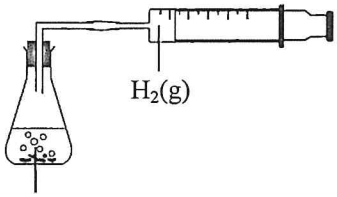
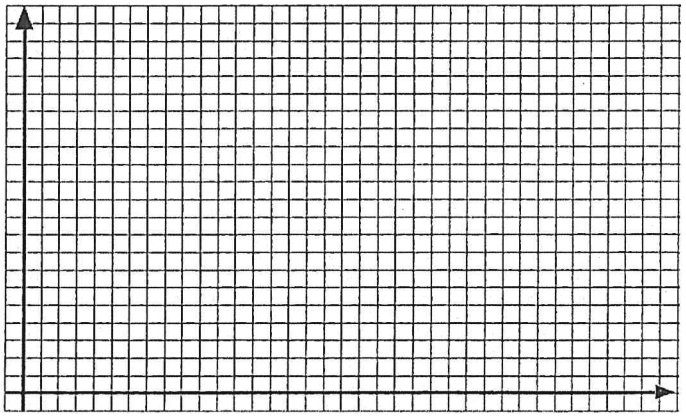
*13. With reference to the set-up shown below, describe how the effect of concentration of HCl(aq) on the rate of the reaction can be studied. Your answer should include **TWO** labelled curves sketched on the graph below, one using **solid line** and the other one using **dotted line**. Label all curves and axes.

(6 marks)



HCl(aq) + Zn(s)
(excess) (fixed mass)



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PERIODIC TABLE 周期表

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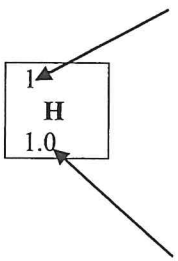

I	II											III	IV	V	VI	VII	0
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 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)

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