YUYING SECONDARY SCHOOL
MID-YEAR EXAMINATION
Secondary 4 Normal (Academic)

NAME _____

CLASS _____ **REG. NO** _____

SCIENCE 5105/3, 5105/4

Chemistry **14 May 2018**

1 hour 15 minutes

Candidates answer on the Question Paper. **Setter: Miss Ham Jia Yun**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on this question booklet and the separate Answer Sheet.

Paper 3

There are **twenty** questions on 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 separate Answer Sheet.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised not to spend more than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.

Read the instructions on the Answer Sheet very carefully.

Paper 4

Answer **all** questions in Section A and any **two** questions in Section B.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
In calculations, you should show all the steps in your working, giving your answer at each stage.
The number of marks is given in brackets [ ] at the end of each question or part question.

The use of an approved calculator is expected, where appropriate.
A copy of the Periodic Table is printed on page 13.

For Examiner's Use	
Total	50

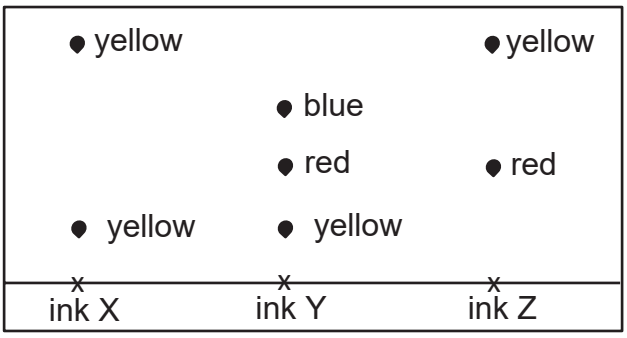
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Paper 3

Answer **all** the questions in this paper on the separate Answer Sheet.
The total mark for this section is 20.

1 The diagram shows a chromatogram obtained from three different inks, X, Y and Z.



How many different **yellow** dyes are present in the inks?

A 1
B 2
C 3
D 4

2 Which row describes the test for hydrogen?

	test	**observation**
A	glowing splint	relights
B	limewater	white precipitate forms
C	red litmus	turns blue
D	lighted splint	flame extinguished with a ‘pop’ sound

3 The nucleus of an atom has neutrons and protons. Electrons are found in different shells around the nucleus.
Which statement correctly describes an atom?

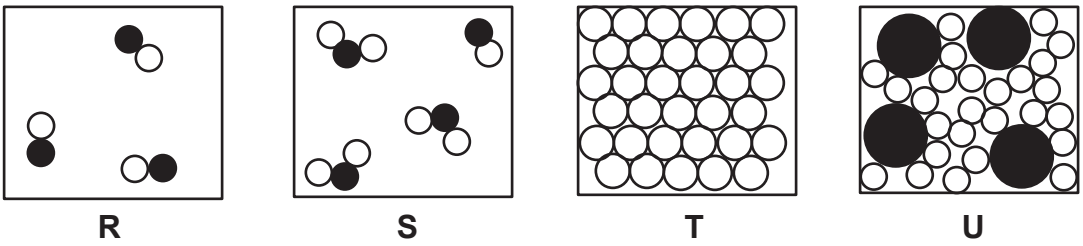
A Neutrons and electrons have the same relative mass.
B The nucleus contains most of the mass of an atom.
C The protons and electrons repel each other.
D The nucleus has a neutral charge.

4 Which substance is a solid at 20 °C?

	melting point/ °C	boiling point/ °C
A	-117	78
B	-93	69
C	0	100
D	36	130

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5 The diagrams show the arrangement of particles in four substances labelled **R**, **S**, **T** and **U**.



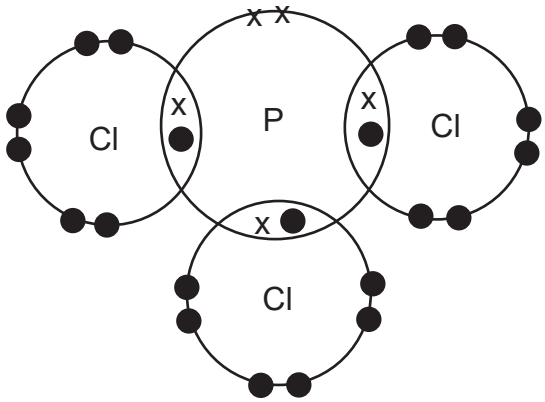
Which row correctly describes these four substances?

	R	S	T	U
A	compound	compound	element	compound
B	element	compound	compound	mixture
C	element	mixture	compound	compound
D	compound	mixture	element	mixture

6 What change occurs when an atom forms a positive ion?

A An electron is added.
B An electron is removed.
C A proton is added
D A proton is removed.

7 The dot-and-cross diagram shows a molecule of phosphorus trichloride.



In the molecule of phosphorus trichloride,

A the phosphorus atom and chlorine atoms share three pairs of electrons.
B the phosphorus atom and chlorine atoms share three pairs of protons.
C the phosphorus atom gives the chlorine atoms three protons.
D the phosphorus atom gives the chlorine atoms three electrons.

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8 What is the relative molecular mass of a fluorine molecule, F_2?

A 9
B 18
C 19
D 38

9 A hydrocarbon C_xH_y has a relative molecular mass of 44.
What are the values of **x** and **y**?

	x	**y**
A	3	6
B	3	8
C	6	3
D	6	6

10 Salts can be prepared by reacting dilute hydrochloric acid with

1. a metal,
2. a metal oxide,
3. a metal carbonate.

Which reactants can be used with dilute hydrochloric acid to prepare copper(II) chloride?

A 1 and 2 only B 1 and 3 only C 2 and 3 only D 1, 2 and 3

11 For which acid-base reaction is the titration method used?

A an insoluble acid with an insoluble base
B an insoluble acid with a soluble base
C a soluble acid with an insoluble base
D a soluble acid with a soluble base

12 Which compound contains three different non-metallic elements?

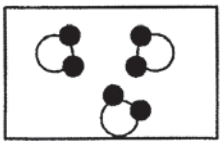
A C_2H_5Br B $LiBH_4$ C Na_2CO_3 D KNO_3

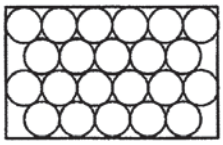
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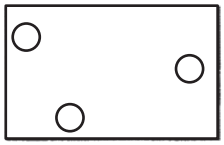
13 Which property of an element determines its position in the Periodic Table?

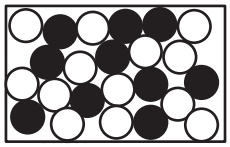
A mass number
B proton number
C neutron number
D nucleon number

14 Which diagram represents the arrangement of atoms in an alloy?

A 

B 

C 

D 

15 Which substance has the properties of a metallic element?

	melting point/ °C	**boiling point/ °C**	**heat conductivity**
A	-102	-34	good
B	-102	-34	poor
C	1535	2750	good
D	1535	2750	poor

16 Which of the following is a property of **all** metals?

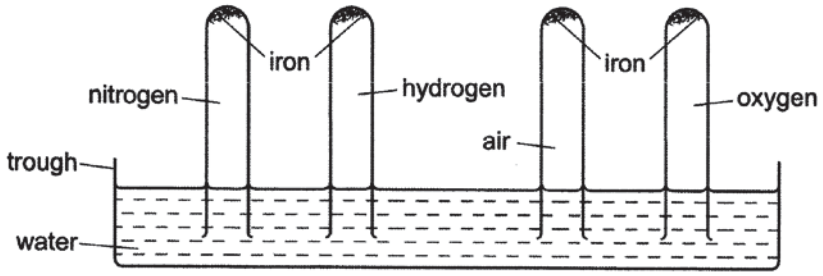
A They conduct electricity.
B They are soluble in water.
C They have high melting points.
D They react with dilute sulfuric acid

17 What is the volume of oxygen in 100 cm^3 of air measured at room temperature?

A 10 cm^3
B 20 cm^3
C 80 cm^3
D 100 cm^3

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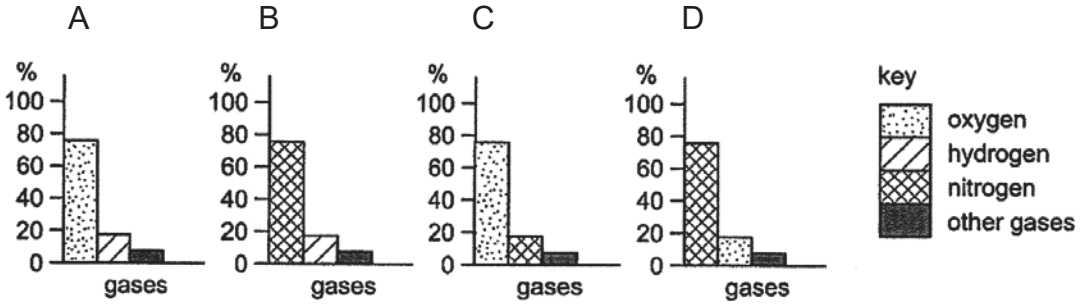
18 The experiment shown in the diagram is set up.



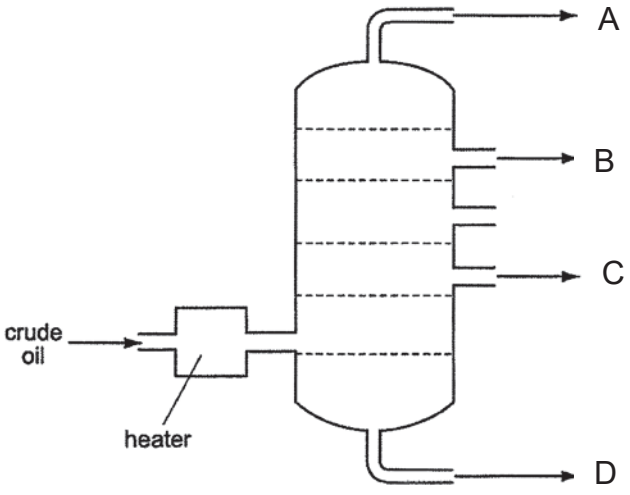
The apparatus is left for one month.
The water level rises the most in the tube containing

A nitrogen.
B hydrogen.
C air.
D oxygen.

19 Which bar chart best represents the approximate composition by volume of air?



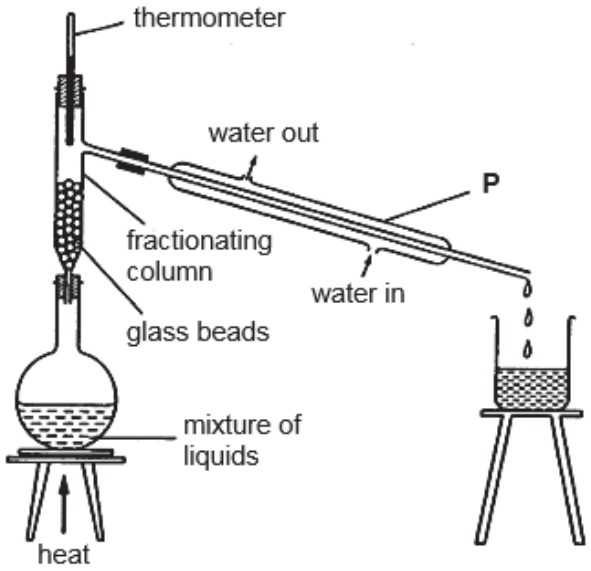
20 The diagram shows a fractionating column.
Which fraction is used for making roads?



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Paper 4 (Section A)
Answer **all** the questions in this section.
The total mark for this section is 14.

1 Ethanol boils at 78 °C, butanol boils at 118 °C and water boils at 100 °C. The following apparatus was set up to separate a mixture of these three liquids.



(a) What is the name of this method of separation? [1]

_____

(b) Name the apparatus labelled **P**. [1]

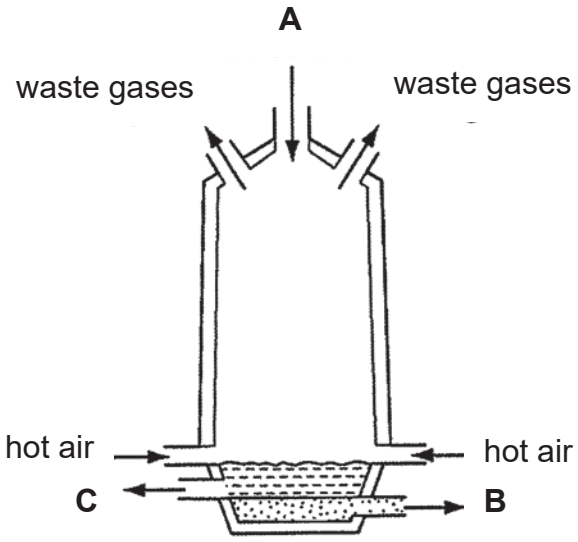
_____

(c) Name the three liquids, ethanol, butanol and water, that will be collected as the distillate in the correct sequence. [1]

sequence of substance collected	1st	2nd	3rd
name of liquid			

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2 The diagram below shows the extraction of iron in a blast furnace.



(a) (i) State the chemical names of the three starting materials added at **A**. [2]

_____ and _____ and _____

(ii) Suggest the identity of two gases present in the waste gases. [1]

_____ and _____

(b) Write the balanced chemical equation for the reaction to produce substance **B**. [2]

_____

3 The formulae of ionic compounds can be deduced from the charges on the ions present. The following list shows the symbols of some common ions.

Na^+ Mg^{2+} Al^{3+}

Br^- O^{2-} CO_3^{2-}

Write the chemical formula and calculate the relative molecular mass for each of the following compounds. [6]

chemical name	chemical formulae	relative molecular mass
sodium oxide		
magnesium bromide		
aluminium carbonate		

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Paper 4 (Section B)

Answer any **two** questions in this section in the spaces provided.
The total mark for this section is 16.

4 (a) Crude oil is a mixture of different hydrocarbons.

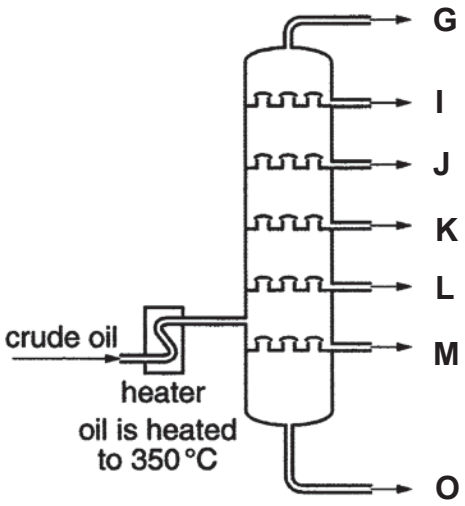
(i) Name the process by which liquids such as petrol and diesel are obtained from crude oil. [1]

_____

(ii) What physical property of all the fractions makes this separation process possible? [1]

_____

(b) The diagram shows the fractions obtained after the process named in (a)(i) was carried out. The fractions are labelled **G**, **I**, **J**, **K**, **L**, **M** and **O**.



(b) (i) Which of the letters **G** to **O** represents the fraction with the lowest boiling point? [1]

_____

(ii) Name one compound likely to be present in the fraction you named in (b)(i). [1]

_____

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(iii) Name the fraction **L**, and state its use. [2]

_____

_____

(iv) **I** undergoes complete combustion to produce water and a gas. [2]
Name the gas produced and describe a test to identify it.

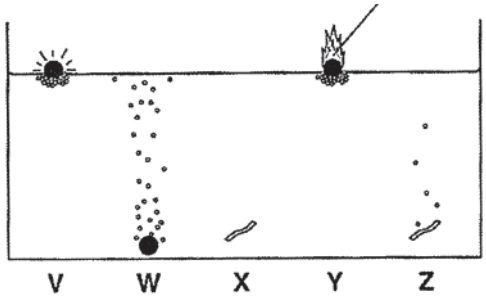
Name: _____

Test: _____

Observation: _____

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5 Five metals **V**, **W**, **X**, **Y** and **Z** are placed in a trough of cold water.
The results observed are shown in the diagram.



(a) Complete the table with the letters **V**, **W**, **X**, **Y** and **Z** to identify the given metals. [3]

metal	letter **V**, **W**, **X**, **Y** and **Z**
calcium	
copper	
magnesium	
potassium	
sodium	

(b) Four of the metals react with cold water to produce a gas.

(i) Name the gas. [1]

_____

(ii) Describe a test and its observation to identify this gas named in (b)(i). [2]

Test: _____

Observation: _____

(iii) Use a 'dot and cross' diagram to show the bonding in the compound named in (b)(i). [2]

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6 Carbon monoxide and oxides of nitrogen are common pollutants in the air.

(a) Name a source of each pollutant and state **one** problem that each pollutant can cause.

(i) carbon monoxide [2]

source: _____

problem: _____

(ii) oxides of nitrogen [2]

source: _____

problem: _____

(b) Sulfur dioxide, SO_2, is released into the atmosphere due to volcanic eruptions. The sulfur dioxide then reacts with water vapour and oxygen to produce sulfuric acid.

(i) Balance the chemical equation for the reaction. [1]

_____ SO_2 + _____ O_2 + _____ H_2O → _____ H_2SO_4

(ii) The sulfur dioxide dissolves in rainwater to form acid rain. This phenomenon causes the decrease in pH levels of soils.

Describe a test to show that the soil is acidic. [2]

test: _____

observation: _____

(iii) Name a substance farmers often add to soils to reduce its acidity. [1]

_____

END OF PAPER

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The Periodic Table of Elements

Group																
I	II										III	IV	V	VI	VII	0
							1 H hydrogen 1									2 He helium 4
3 Li lithium 7	4 Be beryllium 9										5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24										13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key: proton (atomic) number; atomic symbol; name; relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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Paper 3

1	2	3	4	5
B	D	B	D	D
6	7	8	9	10
B	A	D	B	C
11	12	13	14	15
D	A	B	D	C
16	17	18	19	20
A	B	D	D	D

Section A

1	a	Fractional Distillation
	b	condenser
	c	1st: ethanol, 2nd: water, 3rd: butanol
2	a	iron(III) oxide, carbon and calcium carbonate (1m for two correct)
	b	carbon dioxide/ carbon monoxide/ nitrogen/ argon/ oxygen
	c	$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$

3

chemical name	chemical formulae	relative molecular mass
sodium oxide	Na_2O	62
magnesium bromide	$MgBr_2$	184
aluminium carbonate	$Al_2(CO_3)_3$	234

Section B

4	a	i	Fractional Distillation
		ii	Different boiling points
	b	i	G
		ii	methane
		iii	Diesel. Fuel for diesel engines
		iv	Name: carbon dioxide test: bubble the gas through limewater/ calcium hydroxide observation. If the gas is carbon dioxide, a white precipitate is formed.

5 a

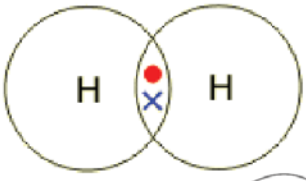
metal	letter **V**, **W**, **X**, **Y** and **Z**
calcium	W
copper	X
magnesium	Z
potassium	Y
sodium	V

2 correct- 1m, 4 correct- 2m, all correct- 3m

	b	i	hydrogen
		ii	Test: insert a lighted splint into the test-tube

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			Observation: If the gas is hydrogen, the lighted splint extinguishes with a pop sound
		iii	 Deduct ½ m for each mistake, include legend
6	a	i	source- incomplete combustion of carbon containing fuels in motor vehicle engines problem- poisonous as it forms a stable compound with haemoglobin in our blood, preventing it from carrying oxygen
		ii	source- lightning activities problem- it combines with rainwater to form acid rain which damages buildings and lungs
	b	i	2, 1, 2, 2
		ii	Test: place moist both blue and red litmus paper into the soil. Observation: red moist litmus paper remains red, blue litmus paper turns red. *accept any possible answers
		iii	calcium hydroxide

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