JAWAPAN

BAB 1

Pengenalan kepada Kimia
Introduction to Chemisty

1.1 Perkembangan Bidang Kimia dan Kepentingan dalam Kehidupan
Development in Chemistry and Its Importance in Life

2. struktur, sifat-sifat, komposisi, interaksi
structure, properties, composition, interaction

3. (a) Pengawet / *Preservative*
(b) analgesik / *analgesic*
(c) aloi / *alloy*
(d) Baja / *Fertiliser*

4. (a) kimia / *Chemistry*
(b) Nanoteknologi / *Nanotechnology*

5. (c) – Jurutera / *Engineer*
– Ahli sains makanan / *Food scientist*
(d) – Doktor / *Doctor*
– Ahli farmasi /*Pharmacist*

1.2 Penyiasatan Saintifik dalam Kimia
Scientific Investigation in Chemistry

1. (a) Membuat inferens / *Making an inference*
(b) Mengenal pasti masalah / *Identifying the problem*
(c) Membuat hipotesis / *Making a hypothesis*
(d) Mengenal pasti pemboleh ubah / *Identifying variables*
(e) Mengawal pemboleh ubah / *Controlling the variables*
(f) Merancang eksperimen / *Planning an experiment*
(g) Mengumpul data / *Collecting data*
(h) Mentafsir data / *Interpreting data*
(i) Membuat kesimpulan / *Making a conclusion*
(j) Menulis laporan / *Preparing a report*

Eksperimen 1.2

Hipotesis / *Hypothesis:*
Semakin tinggi suhu air, semakin tinggi keterlarutan garam dalam air.
The higher the temperature of water, the higher the solubility of a salt in water.

Pemboleh ubah dimanipulasikan: Suhu air
Manipulated variable: *Temperature of water*

Pemboleh ubah dimalarkan: Isi padu air // Jisim garam // Masa
Fixed variable: *Volume of water // Mass of salt // Time*

Keputusan / *Result:*

Suhu *Temperature (°C)*	Pemerhatian *Observation*
10	Tidak larut / *Insoluble*
30	Larut sedikit / *Slightly soluble*
80	Larut dengan lengkap / *Completely soluble*

Mentafsir data / *Interpreting data:*
Semua garam larut pada suhu 80°C.
All the salt dissolve at a temperature of 80°C.

Kesimpulan / *Conclusion:*
Apabila suhu air meningkat, keterlarutan garam dalam air meningkat
When the water temperature increases, the solubility of salt in water increases.
Hipotesis diterima.
Hypotesis is accepted.

1.3 Penggunaan, Pengurusan dan Pengendalian Radas dan Bahan Kimia
Uses, Management and Handling of Apparatus and Chemical Substances

1. (a) Melindungi tangan daripada bahan kimia, kecederaan atau jangkitan
Protect the hands from chemicals, injuries and infection
(b) Melindungi kulit, pakaian dan kaki daripada tumpahan bahan kimia
Protect skin, clothing and feet from chemicals spills
(c) Untuk membasuh dan membersihkan mata apabila kemalangan berlaku
To wash and clean the eyes when accidents occur
(d) Melindungi organ pernafasan daripada serbuk atau wasap bahan kimia
Protect respiratory organ from chemical powder and fumes

2. (a) minyak parafin / *paraffin oil*
(b) berkunci / *locked*
(c) organik / *Organic*

3. (a) guru / *teacher*
(b) kawasan tumpahan / *accident side*
(c) pasir / *sand*
(d) Bersihkan / *Clean*
(e) Lupuskan / *Dispose*

PRAKTIS SPM 1

Soalan Objektif

1. C **2.** D **3.** A **4.** B **5.** A
6. D

BAB 2

Jirim dan Struktur Atom
Matter and Atomic Structure

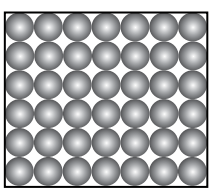
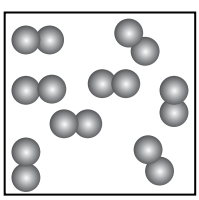
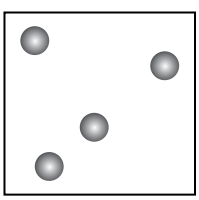
2.1 Konsep Asas Jirim
Basic Concepts of Matter

1. jisim / *mass*

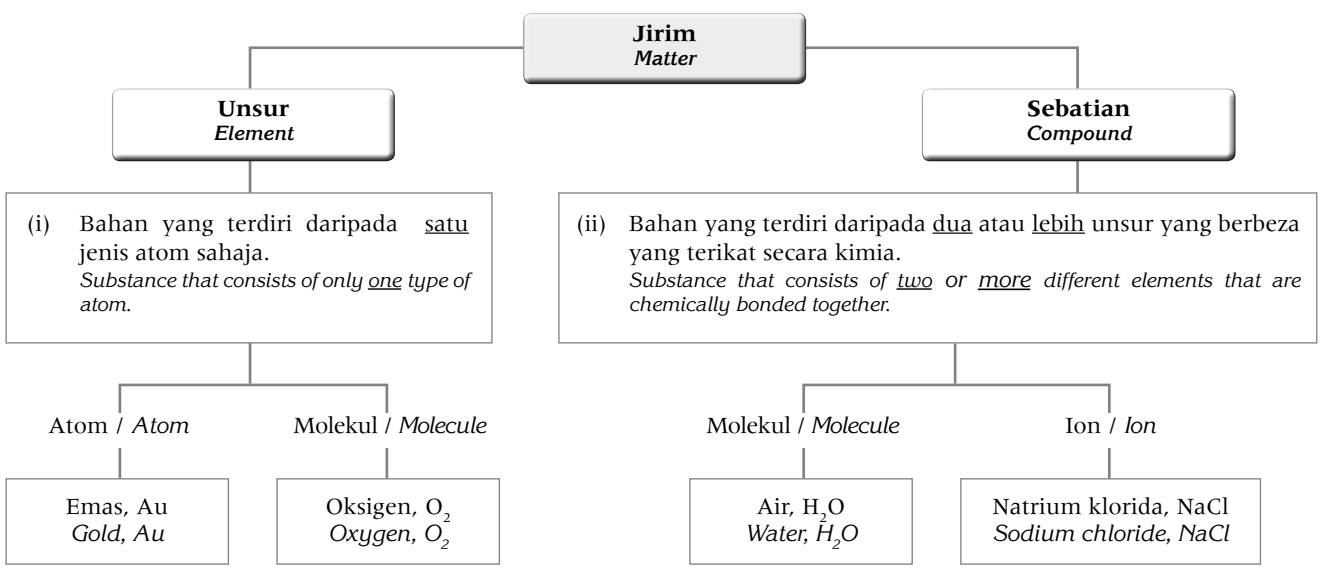
2. halus; diskrit / *fine ; discrete*

3. pepejal; cecair; gas / *solid, liquid, gas*

4. (a) pemanasan; penyejukan / *heating; cooling*
(b) diserap; dibebaskan / *absorbed; released*
(c) tenaga kinetik / *kinetic energy*
(d) pepejal, cecair / *solid, liquid*
(e) cecair, pepejal / *liquid, solid*
(f) tenaga kinetik / *kinetic energy*

Keadaan jirim *State of matter*	**Pepejal** *Solid*	**Cecair** *Liquid*	**Gas** *Gas*
Rajah *Diagram*			
Susunan zarah-zarah *Arrangement of particles*	Zarah-zarah tersusun dengan padat dan dalam keadaan teratur. *The particles are closely packed together in an orderly manner.*	Zarah-zarah tersusun dengan padat tetapi tidak teratur. *The particles are closely packed but not in an orderly manner.*	Zarah-zarah berjauhan antara satu sama lain dan bergerak secara rawak. *The particles are far apart and move randomly.*
Daya tarikan antara zarah-zarah *Force of attraction between particles*	Daya tarikan yang sangat kuat antara zarah-zarah. *Force of attraction between particles is very strong.*	Daya tarikan antara zarah kuat tetapi lebih lemah berbanding di dalam pepejal. *Force of attraction between the particles is strong but weaker than in the solid.*	Daya tarikan antara zarah adalah lemah. *Force of attraction between particles are weak.*
Tenaga kinetik *Kinetic energy*	Tenaga kinetik sangat rendah. *Kinetic energy is very low.*	Tenaga kinetik lebih tinggi daripada pepejal. *Kinetic energy is higher than solid.*	Tenaga kinetik sangat tinggi. *Kinetic energy is very high.*

4.



5.

Zarah
Particles

(i) Atom *Atom*	(ii) Molekul *Molecule*	(iii) Ion *Ion*
Zarah paling kecil bagi suatu unsur yang mengambil bahagian dalam sesuatu tindak balas kimia. *The smallest particle of an element that participates in a chemical reaction.*	Zarah neutral yang terdiri daripada dua atau lebih atom yang berpadu secara kimia. *A neutral particle consists of two or more atoms which are chemically bonded together.*	Zarah yang bercas positif iaitu kation atau negatif iaitu anion. *A positively-charged particle, cation or negatively-charged particle, anion.*

Eksperimen 2.1

A Pemanasan naftalena
Heating of naphthalene

Prosedur / *Procedure*:

1. tabung didih; termometer / *boiling tube; thermometer*

2. bawah / *below*

3. sekata; 60 °C / *uniform, 60 °C*

4. 30 s; 90 °C / *30 s; 90 °C*

B Penyejukan naftalena
Cooling of naphthalene

Prosedur / *Procedure*:

2. kelalang kon / *conical flask*

3. 30 s; 60 °C

Keputusan dan perbincangan / *Results and discussion:*

A Pemanasan naftalena
Heating of naphthalene

Titik *Point*	**Keadaan jirim** *State of matter*	**Penerangan** *Explanation*
A – B	Pepejal *Solid*	Apabila dipanaskan, zarah-zarah menyerap tenaga haba dan menyebabkan tenaga kinetik bertambah. Suhu meningkat. *When heated, the particles absorb heat energy causing the kinetic energy to increase. Temperature increases.*
B – C	Pepejal dan cecair *Solid and liquid*	Tiada peningkatan suhu kerana tenaga haba yang diserap oleh zarah-zarah digunakan untuk mengatasi daya tarikan antara zarah. Peleburan berlaku. *No increase in temperature because heat energy absorbed by the particles is used to overcome the force of attraction between the particles. Melting occurs.*
C – D	Cecair *Liquid*	Apabila dipanaskan, zarah-zarah menyerap tenaga haba dan menyebabkan tenaga kinetk bertambah. Suhu meningkat. *When heated, the particles absorb heat energy causing the kinetic energy to increase. Temperature increases.*

B Penyejukan naftalena
Cooling of naphthalene

Titik *Point*	Keadaan jirim *State of matter*	Penerangan *Explanation*
E – F	Cecair *Liquid*	Apabila disejukkan, zarah-zarah yang membebaskan tenaga haba menyebabkan tenaga kinetik berkurang. Suhu menurun. *When cooled, the particles release heat energy causing the kinetic energy to decrease. Temperature decreases.*
F – G	Pepejal dan cecair *Solid and liquid*	Tiada pengurangan suhu kerana haba yang dibebaskan oleh zarah-zarah diseimbangkan dengan tenaga haba yang dibebaskan semasa zarah-zarah menarik antara satu sama lain untuk membentuk pepejal. Pembekuan berlaku. *No decrease in temperature because heat released by the particles is used to balance the heat released during the attraction of particles with one another to form a solid. Freezing occurs.*
G – H	Pepejal *Solid*	Apabila disejukkan, zarah-zarah membebaskan tenaga haba menyebabkan tenaga kinetik berkurang. Suhu menurun. *When cooled, the particles release heat energy causing the kinetic energy to decrease. Temperature decreases.*

Kesimpulan:
Conclusion

Takat lebur dan takat beku naftalena adalah sama, iaitu 80 °C.
The melting and freezing points of napthalene are the same, that is 80 °C.

2.2 Perkembangan Model Atom
The Historical Development of the Atomic Model

1.

Zarah *Particle*	Simbol *Symbol*	Cas relatif *Relative charge*	Jisim relatif *Relative mass*
(a) Proton *Proton*	p	+1	1
(b) Elektron *Electron*	e	–1	$\frac{1}{1840}$
(c) Neutron *Neutron*	n	0	1

2.

Penemuan / *Discovery*
Atom ialah jasad kecil berbentuk sfera yang tidak boleh dicipta, dimusnahkan atau dibahagi lagi *Atom is the smallest spherical body that cannot be created, destroyed or divided further*
(i) Menjumpai elektron *Discovered electron* (ii) Atom ialah sfera yang bercas positif *Atom is a positively charged sphere*
(i) Menjumpai proton di dalam nukleus *Discovered protons in the nucleus* (ii) Jisim atom bertumpu di dalam nukleus *Atomic mass of atom is concentrated in the nucleus*
Menjumpai elektron dalam atom bergerak pada petala mengelilingi nukleus *Discovered electrons in an atom moving in shells around the nucleus*
(i) Menjumpai neutron di dalam nukleus *Discovered neutrons in the nucleus* (ii) Hampir separuh jisim atom disumbangkan oleh neutron *Almost half of the mass of an atom is contributed by neutrons*

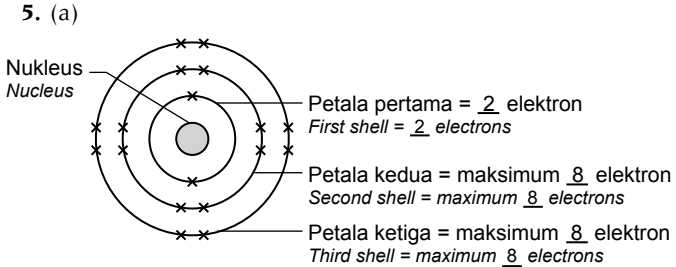
2.3 Struktur Atom
Structure of the Atom

1. (a) proton / *protons*
(b) proton, neutron / *protons, neutrons*

3. (a) Nombor nukleon / *Nucleon number* = 12
Nombor proton / *Proton number* = 6
Bilangan elektron / *Number of electrons* = 6
(b) Nombor nukleon / *Nucleon number* = 16
Nombor proton / *Proton number* = 8
Bilangan elektron / *Number of electrons* = 8
(c) Nombor nukleon / *Nucleon number* = 14
Nombor proton / *Proton number* = 7
Bilangan elektron / *Number of electrons* = 7

4. Neutrol, sama / *neutrol, same*

5. (a)



(b)

Unsur *Element*	**Number proton** *Proton number*	**Susunan elektron** *Electron arrangement*
He	2	2
Li	3	2.1
Be	4	2.2
C	6	2.4
N	7	2.5
O	8	2.6
Na	11	2.8.1
Mg	12	2.8.2
Al	13	2.8.3
S	16	2.8.6
Cl	17	2.8.7
Ar	18	2.8.8
K	19	2.8.8.1
Ca	20	2.8.8.2

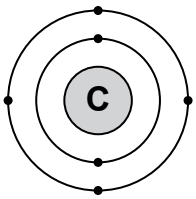
(c)

$^{12}_{6}C$

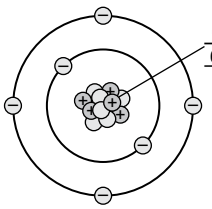
Nombor nukleon = 12
Nucleon number

Nombor proton = 6
Proton number

Bilangan elektron = 6
Number of electrons



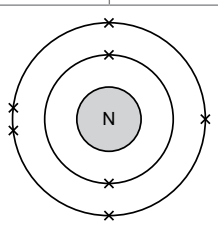
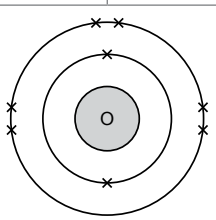
Susunan elektron : 2.4
Electron arrangement

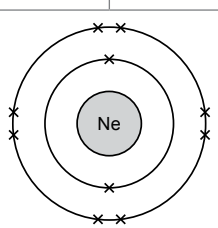
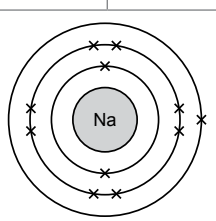


6 proton dan 6 neutron
6 *protons and* 6 *neutrons*

Struktur atom
Atomic structure

Tugasan 1

Unsur *Element*	Nitrogen, N *Nitrogen, N*	Unsur *Element*	Oksigen, O *Oxygen, O*
Nomber proton *Proton number*	7	Nomber proton *Proton number*	8
Susunan elektron *Electron arrangement*	2.5	Susunan elektron *Electron arrangement*	2.6
			

Unsur *Element*	Neon, Ne *Neon, Ne*	Unsur *Element*	Natrium, Na *Sodium, Na*
Nomber proton *Proton number*	10	Nomber proton *Proton number*	11
Susunan elektron *Electron arrangement*	2.8	Susunan elektron *Electron arrangement*	2.8.1
			

2.3 Isotop dan Penggunaannya
Isotopes and Their Uses

1. nombor proton, nombor nukleon, nombor neutron
proton number, nucleon number, neutron number

2. 24.3

3. (a) kanser / *cancer,* tiroid / *thyroid*
(b) metabolisme / *metabolism*
(c) nuklear / *nuclear*
(d) Karbon-14 /*carbon-14*
(e) Hidrogen-3 / *Hydrogen-3*
(f) paip /*pipes*

PRAKTIS SPM 2

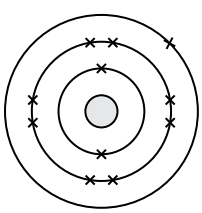
Soalan Objektif

1. C **2.** C **3.** D **4.** A **5.** D
6. B **7.** C

Soalan Struktur

Bahagian A

1. (a) Jumlah bilangan proton dan neutron / *Total number of protons and neutrons*
(b) Aluminium klorida / *Aluminium chloride*
(c) (i) 2.8
(ii) 2.8.4
(d) (i)



(ii) Atom-atom unsur yang sama yang mempunyai nombor proton yang sama tetapi nombor nukleon yang berbeza
Atoms of the same element that have the same proton number but different nucleon numbers
(iii) Untuk mengesan kebocoran paip bawah tanah /
To detect the leakage in underground pipes

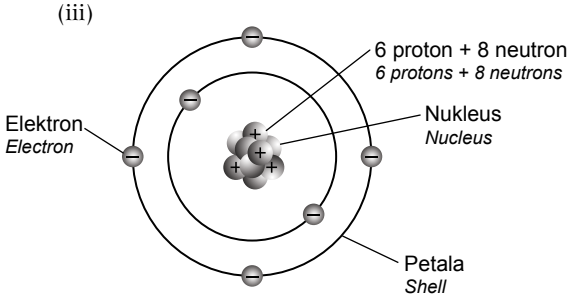
Bahagian B

2. (a) (i) *T : 2.8 U : 2.1 V: 2.4*
(ii) T : 8 *U*: 1 *V*: 4
(iii) Unsur logam: U, unsur bukan logam: *V*
Metal element: U, non-metal element: V

(b) (i)

Persamaan *Similarity*	**Perbezaan** *Difference*
Unsur yang sama iaitu karbon *Same element, that is carbon* Bilangan proton yang sama *Same number of protons* Nombor proton sama *Same proton number* Sifat kimia yang sama *Same chemical properties* [mana-mana dua jawapan] [*any two answers*]	Bilangan neutron yang berbeza *Different number of neutrons* Nombor nukleon berbeza *Different nucleon number* Sifat fizik yang berbeza *Different physical properties* [mana-mana dua jawapan] [*any two answers*]

(ii) Untuk menanggarkan usia fosil dan artifak
To estimate the age of fossils and artefacts
(iii)



1. Lukis nukleus dan petala / *Draw nucleus and shells*
2. Label nukleus dan petala / *Label nucleus and shells*
3. Tunjuk kedudukan neutron dan proton / *Show position of neutrons and protons*
4. Tunjuk kedudukan elektron / *Show position of electrons*
5. Bilangan proton, neutron dan elektron yang betul / *Correct number of protons neutrons, and electrons.*

(c) Terdapat dua isotop utama klorin; klorin-35 dan klorin-37. Dalam mana-mana sampel klorin yang belum diasingkan mengikut berat, terdapat kira-kira 75% atom klorin-35 dan 25% atom klorin-37. Ini memberikan klorin jisim atom relatif sebanyak 35.5 (sebenarnya 35.4527 g/mol).
There are two main isotopes of chlorine; chlorine-35 and chlorine-37. In any chlorine sample that has not been separated by weight, there are about 75% chlorine-35 atoms and 25% chlorine-37 atoms. This gives the relative atomic mass chlorine 35.5 (actually 35.4527 g / mol).

Bahagian C

3. (a) Suhu malar apabila pepejal bertukar menjadi cecair pada tekanan tertentu.
The constant temperature at which a solid changes into a liquid at a particular pressure.

(b) *P* = gas / *gas*
Q = cecair/ *liquid*
R = pepejal / *solid*
S = cecair / *liquid*

(c) Perubahan dari keadaan gas ke cecair
Dari tenaga sangat tinggi ke tenaga sederhana
Dari daya tarikan antara zarah yang lemah / tiada daya tarikan kepada daya tarikan sederhana antara zarah
Change of states from gas to liquid
From high energy to medium energy
From weak / no force between particles to medium force between particles

BAB 3 Konsep Mol, Formula dan Persamaan Kimia
Mole Concept, Formulae and Chemical Equation

3.1 Jisim Atom Relatif dan Jisim Molekul Relatif
Relative Atomic Mass and Relative Molecular Mass

1. (a) kecil, piawai / *small, standard*
(b) karbon -12 / *carbon-12*

2.
$$\text{JAR} = \frac{\text{Jisim purata satu atom unsur}}{\frac{1}{12} \times \text{jisim satu atom karbon-12}}$$
$$\textit{RAM} = \frac{\textit{Average mass of one atom of element}}{\frac{1}{12} \times \textit{mass of one carbon-12 atom}}$$

4. (a) pepejal / *solid*
(b) unsur-unsur / *elements*
(c) 12.0 g / *12.0 g*

5.
$$\text{JMR} = \frac{\text{Jisim purata satu molekul}}{\frac{1}{12} \times \text{jisim satu atom karbon-12}}$$
$$\textit{RMM} = \frac{\textit{Average mass of one molecule}}{\frac{1}{12} \times \textit{mass of one carbon-12 atom}}$$

Formula molekul *Molecular formula*	**Pengiraan** *Calculation*	**JMR / *RMM***
O_2	2 × 16	32
CO_2	12 + (2 × 16)	44
NH_3	14 + (3 × 1)	17

6.

Sebatian ion *Ionic compound*	**Pengiraan** *Calculation*	**JFR** *RFM*
NaCl	23 + 35.5	58.5
K_2O	(39 x 2) + 16	94

Tugasan 1

1.

Bahan *Substance*	**Formula molekul / ion** *Molecular / ionic formula*	**JMR / JFR** *RMM / RFM*
(a) Hidrogen *Hydrogen*	H_2	1 × 2 = 2
(b) Air *Water*	H_2O	(1 × 2) + 16 = 18
(c) Sulfur dioksida *Sulphur dioxide*	SO_2	32 + (2 × 16) = 64
(d) Kalsium karbonat *Calcium carbonate*	$CaCO_3$	40 + 12 + (3 × 16) = 100
(e) Zink nitrat *Zinc nitrate*	$Zn(NO_3)_2$	65 + 2 [14 + (3 × 16)] = 189
(f) Plumbum(II) sulfat *Lead(II) sulphate*	$PbSO_4$	207 + 32 + (4 × 16) = 303
(g) Natrium hidroksida *Sodium hydroxide*	NaOH	23 + 16 + 1 = 40

2. $x(14 + 4) + 32 + (4 \times 16) = 132$
$18x = 132 - 96$
$x = \frac{36}{18}$
$= 2$

3.2 Konsep Mol
Mole Concept

1. kuantiti / *amount*

2. 6.02×10^{23} mol^{-3}

4. satu, g mol^{-1} / *one, g* mol^{-1}
jisim relatif / *relative mass*

Contoh / *Example*
JMR $MgCl_2$ / *RMM of* $MgCl_2$ $= 24 + (2 \times 35.5)$
$= 95$

Jisim $MgCl_2$ / *Mass of* $MgCl_2$ $= 2.0 \times 95$
$= 190$ g

5. satu / *one*
24 dm^3, 22.4 dm^3

Tugasan 2

1.

Bahan *Substance*	Bilangan mol *Number of moles*	Bilangan zarah *Number of particles*
0.5 mole of natrium, Na *0.5 mol sodium, Na*	Na: 0.5 mol	$\underline{0.5} \times (6.02 \times 10^{23}) = \underline{3.01 \times 10^{23}}$ atom Na / *Na atoms*
1.0 mol karbon dioksida, CO_2 *1.0 mol of carbon dioxide,* CO_2	C: 1.0 mol O: 2.0 mol	$\underline{1.0} \times (6.02 \times 10^{23}) = \underline{6.02 \times 10^{23}}$ molekul CO_2 / *molecules of* CO_2 $\underline{1.0} \times (6.02 \times 10^{23}) = \underline{6.02 \times 10^{23}}$ atom C / *C atoms* $\underline{2.0} \times 6.02 \times 10^{23}) = \underline{1.2 \times 10^{24}}$ atom O / *O atoms*

2. (a) Bilangan mol / *Number of moles* $= \dfrac{6.02 \times 10^{22}}{6.02 \times 10^{23}}$
$= 0.1$ mol

(b) Bilangan mol / *Number of moles* $= \dfrac{9.03 \times 10^{22}}{6.02 \times 10^{23}}$
$= 0.15$ mol

3. Jisim molar NaOH $= 23 + 16 + 1 = 40$ g mol^{-1}
Molar mass NaOH

Jisim NaOH $= 2.0 \times 40 = 80$ g
Mass NaOH

4. (a) Bilangan mol / *Number of moles* $= \dfrac{896}{22.4 \times 1000}$
$= 0.04$ mol

(b) Bilangan molekul $= 0.04 \times 6.02 \times 10^{23}$
Number of molecules
$= 2.408 \times 10^{22}$ molekul / *molecules*

(c) Molar mass / *Jisim molar* $= 32 + 2(16)$
$= 64$ g mol^{-1}
Jisim / *Mass* $= 0.04 \times 64$
$= 2.56$ g

3.3 Formula Kimia
Chemical Formulae

1. huruf, subskrip / *alphabets, subscripts*

2. (a) sebenar / *actual*
(b) ringkas / *simplest*

3.

Sebatian *Compound*	Formula molekul *Molecular formula*	Formula empirik *Empirical formula*
Etena / *Ethene*	C_2H_4	CH_2
Glukosa / *Glucose*	$C_6H_{12}O_6$	CH_2O

Contoh 1

Unsur / *Element*	Mg	O
Bilangan Mol / *Number of moles*	$\frac{0.24}{24} = 0.01$	$\frac{0.16}{16} = 0.01$
Nisbah mol / *Mole ratio*	1	1
Formula empirik / *Empirical formula*	MgO	

Contoh 2

Unsur *Element*	C	H	O
Bilangan mol *Number of moles*	$\frac{64.62}{12} = 5.385$	$\frac{10.77}{1} = 10.77$	$\frac{24.61}{16} = 1.538$
Nisbah mol *Mole ratio*	3.5	7	1
Nisbah mol teringkas *Simplest mole ratio*	2	14	2
Formula empirik *Empirical formula*	$C_7H_{14}O_2$		

Contoh 3

Unsur *Elemet*	*T*	I
Bilangan mol *Number of moles*	$\frac{20.15}{T}$	$\frac{100 - 20.15}{127} = 0.63$ mol
Nisbah mol *Mole ratio*	1	2

Bilangan mol, $T = \frac{0.63}{2} \times 1 = 0.315$ mol
Number of moles, T

Jisim atom relatif, $T = \frac{20.15}{0.315} = 64$
Relative atomic mass

Contoh 4

$(CH_3)_n = 30$ $(12 + 3)_n = 30$ $n = \frac{30}{15} = 2$

Formula molekul = $(CH_3)_2 = C_2H_6$
Molecular formula

Eksperimen 3.1

1. penutup / *lid*
2. kertas pasir / *sandpaper*
3. kuat / *strongly*
4. ditimbang / *weighed*
5. tetap / *constant*

Mentafsir data / *Interpreting data*:

Unsur *Element*	**Magnesium, Mg** *Magnesium, Mg*	**Oksigen, O** *Oksigen, O*
Jisim unsur (g) *Mass of element (g)*	$y - x$	$z - y$
Bilangan mol *Number of moles*	$\frac{y - z}{24}$	$\frac{z - y}{16}$
Nisbah mol teringkas *Simplest ratio of moles*	1	2

Perbincangan / *Discussion*:

1. oksigen; magnesium oksida / *oxygen; magnesium oxide*
2. kertas pasir; oksida / *sandpaper; oxide*
3. oksigen; magnesium / *oxygen; magnesium*
4. ditutup; magnesium oksida / *closed ; magnesium oxide*

Kesimpulan / *Conclusion*:
MgO

Eksperimen 3.2

1. ditimbang / *weighed*
2. kuprum(II) oksida / *copper(II) oxide*
3. air / *water*
4. zink; asid hidroklorik / *zinc; Hydrochloric acid*
5. hidrogen / *Hydrogen*

6. dipanaskan / *heated*
7. menyejuk; ditimbang / *cool; weighed*
8. tetap / *constant*

Mentafsir data / *Interpreting data*:

Unsur *Element*	**Kuprum, Cu** *Copper, Cu*	**Oksigen, O** *Oxygen, O*
Jisim unsur (g) *Mass of element (g)*	$z - x$	$y - z$
Bilangan mol *Number of moles*	$\frac{z - x}{64}$	$\frac{y - z}{16}$
Nisbah mol teringkas *Simplest mole ratio*	1	1

Perbincangan / *Disussion*:

1. hidrogen; kuprum / *hydrogen; copper*

2. kuprum; oksigen; kuprum(II) oksida / *copper; oxygen; copper(II) oxide*

Kesimpulan / *Conclusion*:
CuO

Formula kimia bagi sebatian ion
Chemical formulae for ionic compound

Kation *Cation*	**Anion** *Anion*	**Jumlah cas** *Total charge*	**Formula kimia** *Chemical formula*
Mg^{2+}	O^{2-}	(+2) + (–2) = 0	MgO
Mg^{2+}	Cl^{-} (x2)	(+2) + 2(–1) = 0	$MgCl_2$
Mg^{2+}	CO_3^{2-}	(+2) + (–2) = 0	$MgCO_3$
Mg^{2+}	NO_3^{-} (x2)	(+2) + 2(–1) = 0	$Mg(NO_3)_2$
Mg^{2+}	SO_4^{2-}	(+2) + (–2) = 0	$MgSO_4$
Mg^{2+}	OH^{-} (x2)	(+2) + 2(–1) = 0	$Mg(OH)_2$

Tugasan 3

1.

Kation *Cation*	**Simbol** *Symbol*	**Kation** *Cation*	**Simbol** *Symbol*
Ion natrium / *Sodium ion*	Na^{+}	Ion kalsium / *Calcium ion*	Cu^{+2}
Ion kalium / *Potassium ion*	K^{+}	Ion zink / *Zinc ion*	Zn^{2+}
Ion hidrogen / *Hydrogen ion*	H^{+}	Ion plumbum(II) / *Lead(II) ion*	Pb^{2+}
Ion argentum / *Silver ion*	Ag^{+}	Ion magnesium / *Magnesium ion*	Mg^{2+}
Ion litium / *Lithium ion*	Li^{+}	Ion ferum(II) / *Iron(II) ion*	Fe^{2+}
Ion ammonium / *Ammonium ion*	NH_4^{+}	Ion ferum(III) / *Iron(III) ion*	Fe^{3+}
Ion kalsium / *Calcium ion*	Ca^{2+}	Ion aluminium / *Aluminium ion*	Al^{3+}

Anion *Anion*	**Simbol** *Symbol*	**Anion** *Anion*	**Simbol** *Symbol*
Ion klorida / *Chloride ion*	Cl^{-}	Ion manganat(VII) / *Manganate(VII) ion*	MnO_4^{-}
Ion bromida / *Bromide ion*	Br^{-}	Ion karbonat / *Carbonate ion*	CO_3^{2-}
Ion iodida / *Iodide ion*	I^{-}	Ion sulfat / *Sulphate ion*	SO_4^{2-}
Ion oksida / *Oxide ion*	O^{2-}	Ion fosfat / *Phosphate ion*	PO_4^{3-}
Ion hidroksida / *Hydroxide ion*	OH^{-}	Ion tiosulfat / *Thiosulphate ion*	$S_2O_3^{2-}$
Ion nitrat / *Nitrate ion*	NO_3^{-}	Ion dikromat(VI) / *Dichromate ion(VI)*	$Cr_2O_7^{2-}$

2.

	Kation *Cation*	Simbol *Symbol*		Kation *Cation*	Simbol *Symbol*
a.	Natrium klorida *Sodium chloride*	NaCl	k.	Kalsium karbonat *Calcium carbonate*	$CaCO_3$
b.	Kalium oksida *Potassium oxide*	K_2O	l.	Zink nitrat *Zinc nitrate*	$Zn(NO_3)_2$
c.	Litium bromida *Lithium bromide*	LiBr	m.	Plumbum(II) sulfat *Lead(II) sulphate*	$PbSO_4$
d.	Argentum klorida *Silver chloride*	AgCl	n.	Ferum(II) klorida *Iron(II) chloride*	$FeCl_2$
e.	Zink oksida *Zinc oxide*	ZnO	o.	Ion ferum(II) sulfat *Iron(II) sulphate*	$FeSO_4$
f.	Plumbum(II) iodida *Lead(II) iodide*	PbI_2	p.	Aluminium klorida *Aluminium chloride*	$AlCl_3$
g.	Zink klorida *Zinc chloride*	$ZnCl_2$	q.	Barium sulfat *Barium sulphate*	$BaSO_4$
h.	Kalsium oksida *Calcium oxide*	CaO	r.	Plumbum(II) nitrat *Lead(II) nitrate*	$Pb(NO_3)_2$
i.	Barium hidroksida *Barium hydroxide*	$Ba(OH)_2$	s.	Kuprum(II) sulfat *Copper(II) sulphate*	$CuSO_4$
j.	Kuprum(II) oksida *Copper(II) oxide*	CuO	t.	Kalsium sulfat *Calcium sulphate*	$CaSO_4$

3.

	Kation *Cation*	Simbol *Symbol*		Kation *Cation*	Simbol *Symbol*
a.	Karbon dioksida *Carbon dioxide*	CO_2	d.	Sulfur dioksida *Sulphur dioxide*	SO_2
b.	Nitrogen dioksida *Nitrogen dioxide*	NO_2	e.	Ammonia *Ammonia*	NH_3
c.	Air *Water*	H_2O	f.	Hidrogen klorida *Hydrogen chloride*	HCl

4. (a)

Sebatian *Compound*	Nama *Name*	Sebatian *Compound*	Nama *Name*
(a) $MgCl_2$	Magnesium klorida *Magnesium chloride*	(d) K_2SO_4	Kalium sulfat *Potassium sulphate*
(b) $FeSO_4$	Ferum(II) sulfat *Iron(II) sulphate*	(e) $ZnCO_3$	Zink karbonat *Zinc carbonate*
(c) $CaCO_3$	Kalsium karbonat *Calsium carbonate*	(f) NH_4Cl	Ammonium klorida *Ammonium chloride*

(b)

Sebatian *Compound*	Nama *Name*	Sebatian *Compound*	Nama *Name*
(a) SO_2	Sulfur dioksida *Sulphur dioxide*	(d) CO_2	Karbon dioksida *Carbon dioxide*
(b) NO	Nitrogen monoksida *Nitrogen monoxide*	(e) CCl_4	Karbon tetraklorida *Carbon tetrachloride*
(c) CS_2	Karbon disulfida *Carbon disulphide*	(f) NO_2	Nitrogen dioksida *Nitrogen dioxide*

3.4 Persamaan Kimia
Chemical Equations

2. (i) karbon; oksigen / *carbon; oxygen*
(ii) karbon dioksida / *carbon dioxide*
(iii) pepejal; gas; gas / *solid; gas; gas*

Tugasan 4

	Persamaan kimia *Chemical equation*
(a)	$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$
(b)	$2KOH + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O$
(c)	$2Cu(NO_3)_2 \longrightarrow 2CuO + 4NO_2 + O_2$
(d)	$Pb(NO_3)_2 + 2NaI \longrightarrow PbI_2 + 2NaNO_3$
(e)	$2Fe + 3Cl_2 \longrightarrow 2FeCl_3$
(f)	$2H_2 + O_2 \longrightarrow 2H_2O$

Tugasan 5

1. Bilangan mol ZnO / *Number of mol ZnO* $= \frac{1.62}{65 + 16} =$ 0.02 mol

Berdasarkan persamaan kimia, 2 mol Zn bertindak balas dengan 1 mol oksigen untuk menghasilkan 2 mol ZnO.
Based on the chemical equation, 2 mol of Zn reacts with 1 mol of oxygen to produce 2 mol of ZnO.

Maka, 0.02 mol Zn bertindak balas dengan 0.01 mol oksigen untuk menghasilkan 0.02 mol ZnO.
Therefore, 0.02 mol of zn reacts with 0.01 mol of oxygen to produce 0.02 mol of ZnO.

∴ Jisim 0.02 mol Zn = $0.02 \times 65 = 1.3$ g
Mass of 0.02 mol of Zn

Jisim 0.01 mol oksigen = $0.01 \times 16 = 0.16$ g
Mass of 0.01 mol of oxygen

2. Number of mol NO_2 / *Bilangan mol* NO_2
$= \frac{140}{2400} = 0.06$ mol

Berdasarkan persamaan kimia, 2 mol $Pb(NO_3)_2$ terurai untuk menghasilkan 4 mol NO_2.
Based on the chemical equation, 2 mol of $Pb(NO_3)_2$ *decomposed to produce 4 mol of* NO_2.

Maka, 0.03 mol $Pb(NO_3)_2$ terurai untuk menghasilkan 0.06 mol NO_2.
Therefore, 0.03 mol $Pb(NO_3)_2$ *decomposed to produce 0.06 mol of* NO_2.

∴ Jisim 0.03 mol $Pb(NO_3)_2$ = 0.03×331
Mass of 0.03 mol of $Pb(NO_3)_2$ = 9.93 g

PRAKTIS SPM 3

Soalan Objektif

1. C **2.** D **3.** C **4.** C **5.** B
6. A **7.** B

Soalan Struktur

Bahagian A

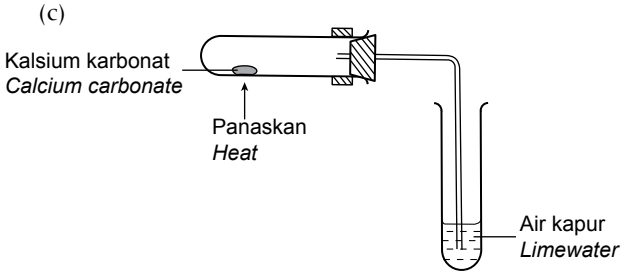
1. (a) Jisim satu atom unsur berbanding 1/12 daripada jisim atom karbon-12.
Mass of one atom of an element compared to 1/12 of the mass of carbon-12 atom.
(b) Lebih mudah dikendali // Lebih stabil
Easier to handle // More stable
(c) 24
(d) (i) $Mg + Cl_2 \rightarrow MgCl_2$
(ii) 1 mol Mg bertindak balas dengan 1 mol Cl_2 untuk menghasilkan 1 mol $MgCl_2$
1 mol of Mg reacts with 1 mol of Cl_2 *to produce 1 mol of* $MgCl_2$
(iii) $n = \frac{2.4}{24} = 0.1$

Nisbah mol	Mg	Cl_2
Mol ratio	0.1	0.1

Maka, bilangan mol klorin = 0.1
So, number of mol of chlorine

2. (a) $CaCO_3$
(b) (i) $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O + CO_2$
(ii) Nisbah mol, $CaCO_3 : CO_2$
Mole ratio 0.5 : 0.5
Maka, isi padu gas $CO_2 = 0.5 \times 24$ dm³
Thus, volume of CO_2 *gas* = 12 dm³

(c)



3. (a) (i) Formula molekul ialah formula yang menunjukkan bilangan sebenar atom setiap unsur dalam suatu sebatian.
Molecular formula is the formula that shows the actual number of atoms of each element in a compound.

(ii) Formula empirik : CH_2
Empirical formula
$(CH_2O)n = 180$
$(12 + 2 + 16)\ n = 180$ // $30\ n = 180$
$n = 6$
Formula molekul / *Molecular formula* = $C_6H_{12}O_6$

(b) – Bahan tindakbalas adalah $C_6H_{12}O_6$ dan O_2
Reactants are $C_6H_{12}O_6$ and O_2
– Hasil tindakbalas adalah CO_2 dan H_2O
Products are CO_2 and H_2O
– 1 mol $C_6H_{12}O_6$ bertindak balas dengan 6 mol O_2 menghasilkan 6 mol CO_2 dan 6 mol H_2O
1 mol of $C_6H_{12}O_6$ reacts with 6 mol of O_2 to produce 6 mol of CO_2 and 6 mol of H_2O

(c) (i) Formula molekul / *Molecular formula*: $C_8H_{10}N_4O_2$
Formula empirik / *Empirical formula* : $C_4H_5N_2O$

(ii)

	$C_8H_{10}N_4O_2$	**$C_4H_5N_2O$**
Jenis zarah *Type of particles*	Molekul *Molecules*	Molekul *Molecules*
Bilangan atom setiap unsur *Number of atoms for each element*	8C, 10H, 4N, 2O	4C, 5H, 2N, O
Jisim molekul relatif *Relative molecular mass*	194	97

(d) (i) $4K + O_2 \rightarrow 2K_2O$

(ii) Jisim formula relatif / *Relative formula mass* : K_2O = 94
Nisbah mol, $4K : 2\ K_2O$
Mol ratio $2K : K_2O$
$n = \frac{19.5}{39}$ Maka / *So* $2K : K_2O$
$39\ \ 0.5K : 0.25\ K_2O$
maka jisim / *mass of* $K_2O = 0.25 \times 94$
$= 23.5$ g

Bahagian C

4. (a)

(i)	KCl
(ii)	$ZNCl_2$
(iii)	KNO_3

(b)

	C	H	O
Jisim (g) *Mass*	40.00%	6.66%	53.33%
Mol	$\frac{40.00}{12}$	$\frac{6.66}{1}$	$\frac{53.33}{16}$
	3.33	6.66	3.33
Teringkas *Simplest*	1	2	1

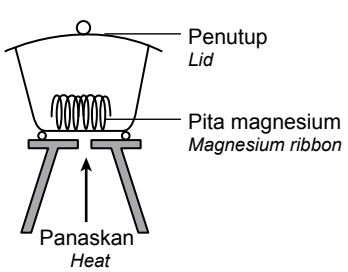
Formula empirik / *Empirical formula*: CH_2O
$(CH_2O)\ n = 180$
$(12 + 2 + 16)\ n = 180$ // $30\ n = 180$
$n = 6$
Formula molekul = $C_6\ H_{12}\ O_6$
Molecular formula

(c) Radas: mangkuk pijar, penunu bunsen, penimbang elektronik, tungku kaki tiga
Apparatus : crucible, bunsen burner, electronic balance, tripod stand
Bahan: pita magnesium, kertas pasir
Materials: magnesium strip, sand paper

1. Timbang mangkuk pijar kosong dan penutup / *Weigh an empty crucible and cover.*
2. Masukkan pita magnesium. Timbang / *Add in magnesium strip. Reweigh.*
3. Panaskan dengan kuat / *Heat the crucible strongly*
4. Buka penutup sekali sekala / *Open the cover once a while*
5. Sejukkan mangkuk pijar dan timbang semula / *Cool the crucible and reweigh*

Jisim mangkuk pijar + penutup (g) *Mass of crucible + cover*	
Jisim mangkuk pijar + Mg (g) *Mass of crucible + Mg*	
Jisim mangkuk pijar + magnesium oksida (g) *Mass of crucible + magnesium oxide*	

2 markah untuk gambarajah berfungsi dan berlabel: Mg, Penutup, Panaskan
2 marks for functional diagram and label: Mg, Cover, Heat



(d) Magnesium oksida merupakan contoh oksida logam reaktif. Formula empirik untuk oksida logam reaktif ditentukan dengan membakar logam dalam udara (tindak balas pengoksidaan). Susunan radas dalam rajah adalah untuk penentuan formula empirik oksida logam kurang reaktif.

Magnesium oxide is an example of a reactive metal oxide. The empirical formula for reactive metal oxides is determined by burning the metal in the air (oxidation reaction). The arrangement of the apparatus in the diagram is for the determination of the empirical formula of the less reactive metal oxide.

BAB 4

Jadual Berkala Unsur
Periodic Table of Elements

4.1 Perkembangan Jadual Berkala Unsur
Development of Periodic Table of Elements

(a) Antoine Lavoiser
(b) Johann W. Dobereiner
(c) John Newlands
(d) Lothar Meyer
(e) Dmitri Mendeleev
(f) Henry Mosely

4.2 Susunan Unsur dalam Jadual Berkala Unsur Moden
Arrangement of Element in the Modern Periodic Table of Elements

1. (a) nombor proton / *proton number*
(b) Kumpulan, elektron valens / *Groups, valence electrons*
(c) Kala, petala / *Periods, shells*

Tugasan 1

Unsur *Element*	**Nombor proton** *Proton number*	**Susunan elektron** *Electron arrangement*	**Elektron valens** *Valence electron*	**Kumpulan** *Group*	**Bilangan petala berisi elektron** *Shells filled with electrons*	**Kala** *Period*
Natrium *Sodium*	11	2.8.1	1	1	3	3
Kalsium *Calcium*	20	2.8.8.2	2	2	4	4
Boron *Boron*	5	2.3	3	13	2	2
Karbon *Carbon*	6	2.4	4	14	2	2
Nitrogen *Nitrogen*	7	2.5	5	15	2	2
Sulfur *Sulphur*	16	2.8.6	6	16	3	3
Klorin *Chlorine*	17	2.8.7	7	17	3	3
Argon *Argon*	18	2.8.8	8	18	3	3

4.3 Unsur dalam Kumpulan 18
Elements in Group 18

1. (b) adi, momoatom
noble, monoatom
(c) duplet, oktet, menerima
Duplet, octet, accept

2. (i) rendah / *low*
(iv) rendah / *Low*

3. (a) bertambah / *increases*
(b) bertambah, kuat, haba / *increases, increases, heat*
(c) bertambah / *Increases*

4. (a) Helium / *Helium*
(b) Neon /*Neon*
(c) Argon / *Argon*
(d) Kripton / *Krypton*
(e) Xenon / *Xenon*
(f) Radon / *Radon*

4.4 Unsur dalam Kumpulan 1
Elements in Group 1

1. (b) alkali / *alkali*
(c) satu / *one*

2. (a) lembut / *Soft*
(b) rendah / *Low*
(c) berkilat / *Shiny*
(d) rendah / *Low*

3. (a) bertambah / *Increases*
(b) berkurang, lemah / *Decreases, weaker*
(c) bertambah / *Increases*

4. (a) sama, satu / *same, one*
(b) 1, duplet, oktet, 1, positif / *1, duplet, octet, 1, positively*
(c)
- bertambah / *increases*
- jauh / *further*
- lemah / *weaker*
- melepaskan, ion positif / *donate, positive ion*

5. A 1. cergas, beralkali, hidrogen / *actively, alkali, hydrogen*
2. $2X\text{OH(ak)}, H_2(g)$ / *2XOH(aq), $H_2(g)$*
B 1. cergas, oksida / *actively, oxide*
$2X_2O(p)$ / *$2X_2O(s)$*
2. alkali / *alkali*
$2X\text{OH(ak)}$ / *2XOH(aq)*
C 1. logam klorida / *metal chloride*
$2X\text{CI(p)}$ / *2XCl(s)*

Eksperimen 4.1

Keputusan / *Results*:

A **Tindak balas unsur Kumpulan 1 dengan air** *Reaction of Group 1 elements with water*	**B** **Tindak balas unsur Kumpulan 1 dengan oksigen** *Reaction of Group 1 elements with oxygen*	**C** **Tindak balas unsur Kumpulan 1 dengan gas klorin** *Reaction of Group 1 elements with clorine gas*
Hipotesis / *Hypothesis*		
Apabila menuruni kumpulan 1, kereaktifan logam alkali dengan air meningkat. *When going down the group, the reactivity of alkali metals with water increases.*	Apabila menuruni kumpulan, kereaktifan logam alkali dengan oksigen meningkat. *When going down the group, the reactivity of alkali metals with oxygen increases.*	Apabila menuruni kumpulan, kereaktifan logam alkali dengan klorin meningkat. *When going down the group, the reactivity of alkali metals with chlorine increases.*
Pemboleh ubah yang dimanipulasikan / *Manipulated variables*		
Jenis logam alkali *Type of alkali metal*	Jenis logam alkali *Type of alkali metal*	Jenis logam alkali *Type of alkali metal*
Pemboleh ubah yang bergerak balas / *Responding variables*		
Keraktifan logam alkali dengan air *Reactivity alkali metals with water*	Keraktifan logam alkali dengan oksigen *Reactivity alkali metals with oxygen*	Keraktifan logam alkali dengan klorin *Reactivity alkali metals with chlorine*
Pemboleh ubah yang dimalarkan / *Fixed variables*		
Saiz logam alkali *Size of alkali metal*	Saiz logam alkali *Size of alkali metal*	Saiz logam alkali *Size of alkali metal*

A

Unsur *Element*	Pemerhatian *Observation*
Litium *Lithium*	Litium bergerak perlahan. Bunyi 'hiss' terhasil. Larutan menukarkan kertas litmus merah ke biru. *Lithium moves slowly. 'Hiss' sound is produced. Solution turns red litmus paper to blue.* Persamaan kimia: $2Li(p) + H_2O(ce) \longrightarrow 2LiOH(ak) + H_2(g)$ *Chemical equation:* $2Li(s) + H_2O(l) \longrightarrow 2LiOH(aq) + H_2(g)$
Natrium *Sodium*	Natrium bergerak cepat, bunyi 'hiss' terhasil. Larutan menukarkan litmus merah ke biru. *Sodium moves quickly. 'Hiss' sound is produced. Solution turns red litmus paper to blue.* Persamaan kimia: $2Na(p) + H_2O(ce) \longrightarrow 2NaOH(ak) + H_2(g)$ *Chemical equation:* $2Na(s) + H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$
Kalium *Potassium*	Kalium bergerak sangat laju dan rawak. Bunyi 'hiss' terhasil dan terbakar dengan nyalaan ungu. *Potassium moves very quickly and randomly. 'Hiss' sound is produced and it burns with a purple flame.* Larutan menukarkan kertas litmus merah ke biru. *Solution turns red litmus paper to blue.* Persamaan kimia: $2K(p) + H_2O(ce) \longrightarrow 2KOH(ak) + H_2(g)$ *Chemical equation:* $2K(s) + H_2O(l) \longrightarrow 2KOH(aq) + H_2(g)$

B

Unsur *Element*	Pemerhatian *Observation*
Litium *Lithium*	Litium terbakar perlahan dengan nyalaan merah. Pepejal putih terhasil. *Lithium burns slowly with a red flame. White solid is produced.* Persamaan kimia: $4Li(p) + O_2(g) \longrightarrow 2Li_2O(p)$ *Chemical equation:* $4Li(s) + O_2(g) \longrightarrow 2Li_2O(s)$
	Pepejal putih larut dalam air membentuk larutan yang menukarkan kertas litmus merah ke biru. *White solid dissolves in water forming a solution that turns red litmus paper to blue.* Persamaan kimia: $Li_2(p) + H_2O(ce) \longrightarrow 2LiO(ak)$ *Chemical equation:* $Li_2(s) + H_2O(l) \longrightarrow 2LiOH(aq)$
Natrium *Sodium*	Natrium terbakar cepat dengan nyalaan kuning. Pepejal putih terhasil. *Sodium burns quickly with a yellow flame. White solid is produced.* Persamaan kimia: $4Na(p) + O_2(g) \longrightarrow 2Na_2O(p)$ *Chemical equation:* $4Na(s) + O_2(g) \longrightarrow 2Na_2O(s)$ Pepejal putih larut dalam air membentuk larutan yang menukarkan kertas litmus merah ke biru. *White solid dissolves in water producing a solution that turns red litmus paper to blue.* Persamaan kimia: $Na_2O(p) + H_2O(ce) \longrightarrow 2NaOH(ak)$ *Chemical equation:* $Na_2O(s) + H_2O(l) \longrightarrow 2NaOH(aq)$
Kalium *Potassium*	Kalium terbakar sangat cepat dan nyalaan ungu. Pepejal putih terhasil. *Potassium burns very rapidly and a purple flame. White solid is produced.* Persamaan kimia: $4K(p) + O_2(ce) \longrightarrow 2K_2O(p)$ *Chemical equation:* $4K(s) + O_2(l) \longrightarrow 2K_2O(s)$ Pepejal putih larut dalam air membentuk larutan yang menukarkan kertas litmus merah ke biru. *White solid dissolves in water producing a solution that turns red litmus paper to blue.* Persamaan kimia: $K_2O(p) + H_2O(ce) \longrightarrow 2KOH(ak)$ *Chemical equation:* $K_2O(s) + H_2O(l) \longrightarrow 2KOH(aq)$

Unsur *Element*	Pemerhatian *Observation*
Litium *Lithium*	Litium terbakar perlahan. Pepejal putih terhasil. *Lithium burns slowly. White solid is produced.* Persamaan kimia: $2Li(p) + CI_2(g) \longrightarrow 2LiCI(p)$ *Chemical equation:* $2Li(s) + Cl_2(g) \longrightarrow 2LiCl(s)$
Natrium *Sodium*	Natrium terbakar cepat. Pepejal putih terhasil. *Sodium burns quickly. White solid is produced.* Persamaan kimia: $2Na(p) + CI_2(g) \longrightarrow 2NaCI(s)$ *Chemical equation:* $2Na(s) + Cl_2(g) \longrightarrow 2NaCl(s)$
Kalium *Potassium*	Kalium terbakar sangat cepat. Pepejal putih terhasil. *Potassium burns very rapidly. White solid is produced.* Persamaan kimia: $2K(p) + CI_2(g) \longrightarrow 2KCI(p)$ *Chemical equation:* $2K(s) + Cl_2(g) \longrightarrow 2KCl(s)$

Perbincangan / *Discussion*:

1. alkali, hidrogen / *alkali, hygrogen*

2. oksida, larut / *oxide, dissolves*

3. klorida / *chloride*

Kesimpulan / *Conclusion*:

1. bertambah / *increases*
diterima / *accepted*

4.5 Unsur dalam Kumpulan 17
Elements in Group 17

1. (b) halogen / *halogens*
(c) tujuh / *seven*

2. (a) bertambah / *increases*
(b) bertambah, kuat, haba / *increases, stronger, heat*
(c) bertambah / *increases*

3. (a) sama / *same*
(b) duplet, octet, negatif / *duplet, octet, negative*
(b) • berkurang / *decreases*
• jauh / *further*
• satu, lemah / *one, weaker*
• ion negatif / *negative ion*

Unsur *Element*	Pemerhatian *Observation*
Klorin *Chlorine*	Klorin larut dengan mudah dalam air suling menghasilkan larutan tidak berwarna / kuning muda. Kertas litmus biru menjadi merah, kemudian putih (luntur). *Chlorine dissolves easily in distilled water producing a colourless solution / pale yellow. Blue litmus paper turns to red, then white (bleached).* Persamaan kimia: $Cl_2(g) + H_2O(ce) \longrightarrow HCl(ak) + HOCl(ak)$ *Chemical equation :* $Cl_2(g) + H_2O(l) \longrightarrow HCl(aq) + HOCl(aq)$
Bromin *Bromine*	Bromin larut dengan perlahan dalam air suling menghasilkan larutan kuning keperangan. *Bromine dissolves slowly in distilled water producing a yellowish brown solution.* Kertas litmus biru menjadi merah kemudian putih (luntur). *Blue litmus paper turns red, then white (bleached).* Persamaan kimia: $Br_2(ce) + H_2O(ce) \longrightarrow HBr(ak) + HOBr(ak)$ *Chemical equation :* $Br_2(l) + H_2O(l) \longrightarrow HBr(aq) + HOBr(aq)$

Iodin *Iodine*	Iodin larut dengan sangat perlahan di dalam air suling menghasilkan larutan perlahan. Litmus biru menjadi merah. *Iodine dissolves very slowly in distilled water producing a brownish red solution. Blue litmus paper turns red.* Persamaan kimia: $I_2(p) + H_2O(ce) \longrightarrow HI(ak) + HOI(ak)$ *Chemical equation :* $I_2(s) + H_2O(l) \longrightarrow HI(aq) + HOI(aq)$

C

Unsur *Element*	Pemerhatian *Observation*
Klorin *Chlorine*	Wul besi terbakar sangat cepat dengan nyalaan terang. Pepejal perang terhasil. *Iron wool burns rapidly and with a bright flame. Brown solid is produced.* Persamaan kimia: $2Fe(p) + 3CI_2(g) \longrightarrow 2FeCl_3(p)$ *Chemical equation :* $2Fe(s) + 3CI_2(g) \longrightarrow 2FeCl_3(s)$
Bromin *Bromine*	Wul besi berbara dengan terang. Pepejal perang terhasil. *Iron wool glows brightly. Brown solid is produced.* Persamaan kimia: $2Fe(p) + 3Br_2(g) \longrightarrow 2FeBr_3(p)$ *Chemical equation :* $2Fe(s) + 2Br_2(g) \longrightarrow 2FeBr_3(s)$
Iodin *Iodine*	Wul besi membara dengan malap cepat. Pepejal perang terhasil. *Iron wool glows dimly. Brown solid is produced.* Persamaan kimia: $2Fe(p) + 3I_2(g) \longrightarrow 2FeI_3(p)$ *Chemical equation :* $2Fe(s) + 3I_2(g) \longrightarrow 2FeI_3(s)$

D

Unsur *Element*	Pemerhatian *Observation*
Klorin *Chlorine*	Gas kuning kehijauan larut dengan mudah di dalam larutan natrium hidroksida menghasilkan larutan tidak berwarna. *Yellowish greenish gas dissolves easily in sodium hydroxide solution to produce a colourless solution.* Persamaan kimia: $Cl_2(g) + 2Na_2OH(ak) \longrightarrow NaCl(ak) + NaOCI(ak) + H_2O(ce)$ *Chemical equation :* $Cl_2(g) + 2NaOH(aq) \longrightarrow NaCl(aq) + NaOCI(aq) + H_2O(l)$
Bromin *Bromine*	Cecair perang larut di dalam larutan natrium hidroksida menghasilkan larutan hampir tidak berwarna. *Brown liquid dissolves in sodium hydroxide solution to produce an almost colourless solution.* Persamaan kimia: $Br_2(ce) + 2NaOH(ak) \longrightarrow NaBr(ak) + NaOBr(ak) + H_2O(ce)$ *Chemical equation :* $Br_2(l) + 2NaOH(aq) \longrightarrow NaBr(aq) + NaOBr(aq) + H_2O(l)$
Iodin *Iodine*	Pepejal hitam larut dengan perlahan di dalam larutan natrium hidroksida menghasilkan larutan hampir tidak berwarna. *Black solid dissolves slowly in sodium hydroxide solution to produce an almost colourless solution.* Persamaan kimia: $I_2(p) + 2NaOH(ak) \longrightarrow NaI(ak) + NaOI(ak) + H_2O(ce)$ *Chemical equation :* $I_2(s) + 2NaOH(aq) \longrightarrow NaI(aq) + NaOI(aq) + H_2O(l)$

Perbincangan / *Discussions*

1. berasid, peluntur, larut / *dissolve, acid, bleaching, dissolves*

2. halida / *halide*

3. larut, tidak berwarna / *dissolve, colourless*

Kesimpulan / *Conclusions*

1. berkurang / *decreases*

4.6 Unsur dalam Kala 3
Elements in Period 3

1.

Unsur *Element*	Na	Mg	Al	Si	P	S	Cl	Ar
Nombor proton *Proton number*	11	12	13	14	15	16	17	18
Susunan elektron *Electron arrangement*	2.8.1	2.8.2	2.8.3	2.8.4	2.8.5	2.8.6	2.8.7	2.8.8
Jejari atom (nm) *Atomic radius(pm)*	0.186	0.160	0.143	0.118	0.110	0.104	0.100	0.094
Keadaan *State*	Pepejal *Solid*						Gas *Gas*	
Elektronegatifan *Electronegativity*	0.9	1.2	1.5	1.8	2.1	2.5	3.0	–
Sifat kelogaman ***Metallic properties***	Logam *Metal*			Separuh logam *Semi-metal*	Bukan logam *Non-metal*			

tiga / *three*

2. A **1.** berkurangan, kecil / *reduces, smaller*

B **1.** bertambah / *increase*
2. terluar / *outermost*
3. bertambah / *increases*

B

Oksida *Oxide*	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_2	Cl_2O_7
Sifat oksida *Oxide properties*	Oksida logam *Metal oxides*			Oksida bukan logam *Non-metal oxides*			
	Oksida bes *Basic oxides*		Oksida amfoterik *Amphoteric oxide*	Oksida asid *Acidic oxides*			
Apabila larut dalam air *When dissolves in water*	Larutan beralkali *Alkaline solution*		–	Larutan berasid *Acidic solution*			
Hasil tindak balas oksida dengan asid *Products of oxide with acid*	Garam dan air *Salt and water*		Garam dan air *Salt and water*	–			
Hasil tindak balas oksida dengan alkali *Products of oxide with alkali*	–		Garam dan air *Salt and water*	Garam dan air *Salt and water*			

Eksperimen 4.2

A Tindak balas oksida unsur Kala 3 dengan air
Reaction of oxides of Period 3 elements with water

Radas / *Apparatus*:
berasid / *acidic*

Pemboleh ubah / *Variables*:
(a) Jenis oksida unsur Kala 3 / *Type of oxide of Period 3 elements*
(b) Perubahan sifat oksida / *Change in oxide property*
(c) Isi padu air / *Volume of water*

Keputusan / *Results*:

Oksida *Oxide*	Na_2O	MgO	Al_2O_3	SO_2
Dengan air *With water*	Larut *Soluble*	Larut sedikit *Slightly soluble*	Tidak larut *Insoluble*	Larut *Soluble*
Nilai pH *pH value*	14	9	–	3

B Tindak balas oksida unsur Kala 3 dengan larutan natrium hidroksida dan asid nitrik
Reaction of oxides of Period 3 elements with sodium hydroxide solution and nitric acid

Pemboleh ubah / *Variables*:
(a) Jenis oksida unsur Kala 3 / *Type of oxide of Period 3 elements*
(b) Keterlarutan / *Solubility*
(c) Isi padu NaOH dan HNO_3 / *Volume of NaOH and HNO_3*

Prosedur / *Procedure*:

Oksida *Oxide*	**Pemerhatian** *Observation*	
	Larutan natrium hidroksida *Sodium hydroxide solution*	**Asid nitric** *Nitric acid*
Magnesium oksida *Magnesium oxide*	Tidak larut *Insoluble*	Larut *Soluble*
Aluminium oksida *Aluminium oxide*	Larut *Soluble*	Larut *Soluble*
Silikon (IV) oksida *Silicon (IV) oxide*	Larut *Soluble*	Tidak larut *Insoluble*

Perbincangan / *Discussion*:

1. Magnesium oksida / *Magnesium oxide*
Aluminium oksida / *Aluminium oxide*
Silicon(IV) oksida / *Silicon(IV) oxide*

2. garam, air / *salt, water*

$$\underline{MgO(p)} + 2HNO_3(ak) \longrightarrow \underline{Mg(NO_3)_2(ak)} + H_2O(ce)$$
$$\underline{MgO(s)} + 2HNO_3(aq) \longrightarrow \underline{Mg(NO_3)_2(aq)} + H_2O(l)$$

3. asid nitrik, garam, air / *nitric acid, salt, water*

$$\underline{Al_2O_3(p)} + 6HNO_3(ak) \longrightarrow 2\underline{Al(NO_3)_2(ak)} + 3H_2O(ce)$$
$$\underline{Al_2O_3(s)} + 6HNO_3(aq) \longrightarrow 2\underline{Al(NO_3)_2(aq)} + 3H_2O(l)$$
$$\underline{Al_2O_3(p)} + 2NaOH(ak) \longrightarrow 2\underline{NaAlO_2(ak)} + H_2O(ce)$$
$$\underline{Al_2O_3(s)} + 2NaOH(aq) \longrightarrow 2\underline{NaAlO_2(aq)} + H_2O(l)$$

4. garam, air / *salt, water*

$$\underline{SiO_3(p)} + 2NaOH_3(ak) \longrightarrow 2\underline{Na_2SiO_3(ak)} + H_2O(ce)$$
$$\underline{SiO_2(s)} + 2NaOH_3(aq) \longrightarrow 2\underline{Na_3SiO_3(aq)} + H_2O(l)$$

Kesimpulan / *Conclusion:*
1, 2, asid, amfoterik, diterima / *1, 2, acidic, amphoteric, accepted*

3. 1. logam, bukan logam / *metallic, non-metallic*
2. silikon, Si, germanium, Ge, tinggi / *silicon, Si, germanium, Ge, high*
3. komputer, telefon bimbit / *computers, mobile phone*

Tugasan 2

(a) (i) Natrium / Magnesium / Aluminium // *Sodium / Magnesium / Aluminium*
(ii) Kumpulan 1, Kala 3 / Kumpulan 2, Kala 3 / Kumpulan 13, Kala 3
Group 1, Period 3 / Group 2, Period 3 / Group 13, Period 3

(b) (i) Argon / *Argon*
(ii) Atom bagi unsur tersebut telah mencapai susunan elektron oktet. Maka, atom tidak menerima atau berkongsi elektron.
Atom of the element has achieved an octet electron arrangement. Therefore, the atom does not accept or share electrons.

(c) (i) $4Na + O_2 \rightarrow 2Na_2O$

(ii)

Nilai pH / *pH value*		
4	7	11
		✓

(d) Klorin. Bilangan proton klorin lebih banyak / Cas positif dalam nukleus klorin lebih banyak / Tarikan nukleus terhadap elektron luar untuk masuk pada petala terluar lebih kuat.
Chlorine. More number of protons in chlorine. / More positive charges in the chlorine nucleus. / The attraction force of nucleus towards the outer electrons to enter the outermost shell is stronger.

4.7 Unsur Peralihan
Transition Elements

1. 2, 12

2. (i) kilat / *Shiny*
(ii) Sangat, ditempa / *Very, malleable*
(iii) tinggi / *High*
(iv) Elektrik /*electricity*
Tinggi / *High*

3. (a) mangin / *catalysts*
(b) berwarna / *coloured*
(c) nombor pengoksidaan / *oxidation numbers*
(d) ion kompleks / *oxidation numbers*

Tindak balas *Reaction*
Penghasilan ammonia dalam proses Haber *Production of ammonia in Haber process*
Penghasilan asid sulfurik dalam proses Sentuh *Production of sulphuric acid in Contact process*
Penghasilan asid nitrik dalam proses Ostwald *Production of nitric acid in Ostwald process*
Pembuatan marjerin (penghidrogenan) *Manufacture of margarine (hydrogenation)*

PRAKTIS SPM 4

Soalan Objektif

1. D **2.** C **3.** D **4.** C **5.** D
6. D **7.** D **8.** B **9.** D **10.** C

Soalan Struktur

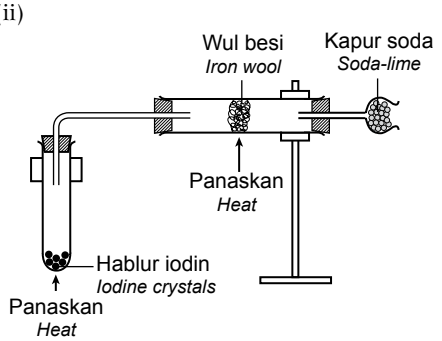
Bahagian A

1. (a) *V*
(b) *R*
(c) (i) 2.8.8.1
(ii) $4R + O_2 \rightarrow 2R_2O$
(d) Susunan elektron oktet / *Octet electron arrangement*
(e) *T*
(f) *S*
(g) Bilangan proton dalam nukleus atom *P* kurang daripada atom *T*, maka daya tarikan antara nukleus dengan elektron valens lebih lemah. Elektron valens mudah didermakan.
Number of protons in nucleus of atom P is less than atom T, so the force between the nucleus and valence electron is weaker. Valence electron are easier to be released.

2. (a) 2.8
(b) Atom natrium lebih besar daripada atom oksigen kerana mempunyai lebih banyak bilangan petala yang berisi elektron.
Sodium atom is bigger than oxygen atom because it has more number of shells filled with electrons.
(c) (i) Na_2O
(ii) $Na_2O + 2HCl \rightarrow 2NaCl + H_2O$
(iii) Nisbah mol / *Mole ratio*, $Na_2O : 2NaCl$
$0.1 : 0.2$
Maka, jisim hasil $= 0.2 \times 58.5$
Thus, mass of products $= 11.7$ g

Bahagian B

3. (a) Karbon terletak di kala ke-2 dan kumpulan ke-14 dalam Jadual Berkala Unsur.
Karbon mempunyai nombor proton 6 dan susunan elektronnya ialah 2.4.
Carbon is located in the 2nd period and the 14th group in the Periodic Table of
Elements. Carbon has 6 proton numbers and the electron arrangement is 2.4.
(b) Susunan elektron *P* = 2.8.2, *Q* = 2.8.8.2
Bilangan elektron valens *P* = 2, *Q* = 2
Maka *P* dan *Q* mempunyai sifat kimia yang serupa kerana kedua-dua mempunyai bilangan elektron valens yang sama.
Electron arrangement for P = 2.8.2, Q = 2.8.8.2
Number of valence electrons P = 2, Q = 2
So, P and Q has same chemical properties because both have the same number of valence electron.
(c) (i) – Permukaan berkilat / *Shiny surface*
– Konduksi elektrik dan haba yang baik / *Good conductor of electricity and heat*
(ii) Besi. Penghasilan ammonia dalam proses Haber.
Iron. Production of ammonia in Haber process.
Persamaan kimia di bawah menunjukkan tindak balas ini:
Equation below show the reaction:
$$N_2\ (g) + 3H_2\ (g) \rightarrow 2NH_3\ (g)$$
(d) (i) Klorin lebih reaktif // *Chlorine is more reactive*
Saiz atom klorin lebih kecil
Jarak antara nukleus dan elektron valens lebih dekat
Kekuatan nukleus untuk menarik satu elektron ke dalam petala adalah lebih kuat
Size atom of chlorine is smaller,
Distance between nucleus and valence electrons is nearer
The strength of the nucleus to attract one electron into the outermost shell is stronger
$$2Fe_2 + 3Cl_2 \rightarrow 2FeCl_3$$
(ii)



Bahagian C

4. (a) (i) *P, M, Q*

(ii) Sulfur dioksida, Aluminium oksida, Magnesium oksida
Sulphur dioxide, Aluminium oxide, Magnesium oxide

(iii) $MgO(p) + 2HNO_3$ (ak) $Mg(NO_3)_2$ (ak) + H_2O (ce)
$MgO(s) + 2HNO_3$ (aq) $Mg(NO_3)_2$ (aq) + H_2O (l)

(b) (i) Gas kuning kehijauan larut / *Greenish yellowish gas dissolves*
Larutan kuning muda/ tidak berwarna terhasil / *Pale yellow solution / Colourless solution*

(ii) $Cl_2 + H_2O \rightarrow HCl + HOCl$

(iii) Biru menjadi merah kemudian putih / *Blue become red then white*
Larutan berasid dan peluntur terhasil / *Acidic solution and bleach is produced*

(c) Radas: bekas kaca, pisau, penyepit
Apparatus : glass container, knife, tweezer
Bahan: litium / natrium, kertas pasir, kertas litmus merah, kertas turas, air
Material: lithium/ sodium, sand paper, red litmus paper, filter paper, water

1. Potong sebutir litium / natrium bersaiz kecil.
Keringkan litium/natrium dengan kertas turas.
Cut a small size lithium/ sodium. Dry the lithium/ sodium with a filter paper.

2. Letakkan litium/ natrium di atas permukaan air.
Celupkan kertas litmus merah apabila tindak balas selesai.
Put the lithium/ sodium onto the water surface. Dip a red litmus paper when the reaction stops

3. Rekodkan pemerhatian / *Record the observations*
Pemerhatian: Litium bergerak / bunyi 'hiss' / litmus merah menjadi biru
Atau Natrium bergerak laju / nyalaan kuning / bunyi 'hiss' yang kuat
Observation: Lithium moves / 'hiss' sound / red litmus becomes blue
Or sodium moves quickly / 'loud 'hiss' sound

BAB 5 Ikatan Kimia
Chemical Bonds

5.1 Asas Pembentukan Sebatian
Basic Compound formation

1. Duplet, oktet, pemindahan, perkongsian
Duplet, octet, transfer, share

2. Ion, kovalen / *ionic, covalent*

5.2 Ikatan Ion
Ionic Bond

1. logam / *metal*
menderma, menerima, oktet, kuat, ion
donates, accept, octet, strong, ionic

2. (a) 2.8.1, satu, 2.8
2.8.1, one, 2.8

(b) Na^+
$Na^+ + e^-$

(c) 2.8.1, +11, –11, 0

3. (a) 2.8.7, tujuh, satu, 2.8.8
2.8.7, seven, one, 2.8.8

(b) Cl^-
$e^- \rightarrow cl^-$

(c) (i) Susunan elektron: 2.8.7
Electron arrangement

Cas 17 proton *Charge of 17 protons*	= +17
Cas 17 elektron *Charge of 17 electrons*	= –17
Jumlah cas *Total charge*	= 0

(c) (ii) Susunan elektron: 2.8.8
Electron arrangement

Cas 17 proton *Charge of 17 protons*	= +17
Cas 18 elektron *Charge of 18 electrons*	= –18
Jumlah cas *Total charge*	= –1

4. (a) Na: 2.8.1, Cl : 2.8.7, Na^+: 2.8, Cl^-: 2.8.8

(b) kuat, ion, natrium klorida, NaCl
Strong, ionic, sodium chloride, NaCl

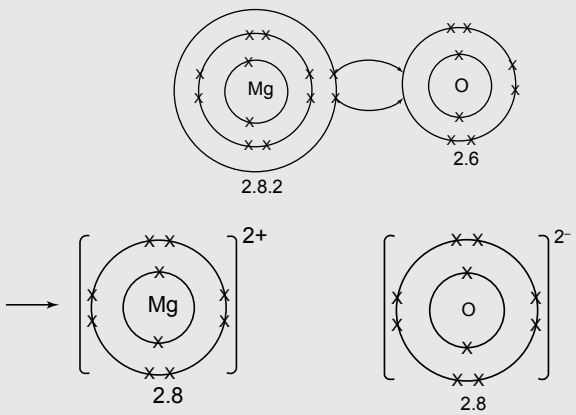
Tugasan 1

1. (ii)

Unsur *Element*	Nombor proton *Proton number*	Susunan elektron *Electron arrangement*
Mg	12	2.8.2
O	8	2.6

Persamaan setengah : $Mg \rightarrow \underline{Mg^{2+}} + \underline{2e^-}$,
Half equation:
$O + \underline{2e^-} \rightarrow \underline{O^{2-}}$,

Daya yang kuat antara Mg^{2+} dan O^{2-} menghasilkan <u>MgO</u>.
Strong force between Mg^{2+} and O^{2-} produces <u>MgO</u>.



5.3 Ikatan Kovalen
Covalent Bond

1. bukan logam, kovalen / non-metal, covalent
Berkongsi, oktet, kovalen / share, octet, covalent

2. (a) 1, satu, 2 / *1, one, 2*
(b) 2.8.7, tujuh, 2.8.8 / *2.8.7, seven, 2.8.8*

Susunan elektron / *Electron arrangement*			
H: 1	Cl: 2.8.7	H: 2	Cl: 2.8.8

3. (a) satu /*one*
(b) dua / *two*
(c) tiga / *three*

4. terluar / *outermost*

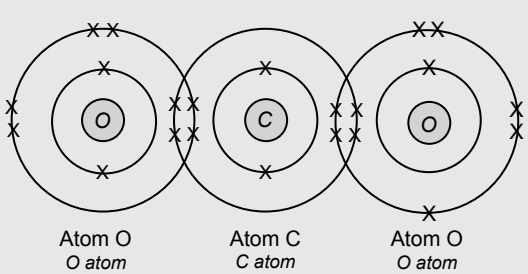
5.

Ikatan Ion *Ionic Bond*		**Ikatan Kovalen** *Covalent Bond*
Perbezaan *Differences*	Persamaan *Similarities*	Perbezaan *Differences*
(a) Pemindahan elektron. *Transfer of electron.*	Melibatkan elektron valens sahaja. *Involve valence electrons only.*	(a) Perkongsian elektron. *Sharing of electron.*
(b) Antara logam(Kumpulan 1, 2 dan 13) dengan bukan logam (Kumpulan 15, 16 dan 17). *Between metal (Group 1, 2 and 13) and non-metal (Group 15, 16 and 17).*	Atom mencapai susunan elektron duplet atau oktet yang stabil. *Atom achieves the stable duplet or octet electron arrangements.*	(b) Antara atom bukan logam dengan bukan logam (Kumpulan 14, 15, 16 dan 17). *Between non- metals and non-metals (Group 14, 15, 16 dan 17).*
(c) Membentuk ion positif dan ion negatif *Form positive ion and negative ion.*		(c) Membentuk molekul. *Form molecule.*

Tugasan 2

Unsur / *Element*	**Nomber proton / *Proton number***	**Susunan elektron / *Electron arrangement***
C	6	2.4
O	8	2.6

Atom karbon mempunyai empat elektron valens dan memerlukan empat elektron untuk mencapai susunan oktet, 2.8.
Carbon atom has four valence electrons and need four electrons to achieve an octet, 2.8 electron arrangement.
Atom oksigen mempunyai enam elektron valen dan memerlukan dua elektron untuk mencapai susunan oktet, 2.8.
Oxygen atom has six valence electrons and need two electrons to achieve an octet, 2.8 electron arrangement.
Maka, satu atom karbon menyumbang empat elektron untuk dikongsikan dengan dua atom oksigen manakala setiap satu atom oksigen menyumbang dua elektron untuk dikongsikan.
Thus, one carbon atom contributes four electrons to be shared with two oxygen atoms whereas each oxygen atom contributes two electrons to be shared.
Dua ikatan kovalen ganda dua terhasil. Molekul karbon dioksida, CO_2 terhasil.
Two double covalent bonds are produced. Carbon dioxide molecule, CO_2 is produced.



Atom O *O atom* | Atom C *C atom* | Atom O *O atom*

2 ikatan ganda dua
2 *double covalent bonds*

(Struktur lewis / *Lewis structure*)
O = C = O

Molekul karbon dioksida CO_2
Carbon dioxide molecule

5.4 Ikatan Hidrogen
Hydrogen Bond

1. daya; hidrogen; keelektronegatifan; nitrogen, N; oksigen, O; fluorin, F
force; hydrogen; electronegativity;nitrogen, N; oxygen, O; fluorin, F.

2. (a) berkongsi, kovalen, duplet, 2 , oktet, 2.8
shares, covalent, duplet, 2, octet, 2.8
(b) keelektronegatifan, daya / *electronegativity, force*
hidrogen / hydrogen

3. (a) basah / *Wet*

4. (b) lemah, antara molekul, kuat, tinggi
weaker, intermolecular, stronger, higher
(c) ammonia, etanol, hidrogen, air, elektronegatif
ammonia, ethanol, hydrogen, water, electronegative
(d) tinggi, hidrogen, haba / *higher, hydrogen, heat*

5.5 Ikatan Datif
Dative Bond

1. koordinat, elektron, satu / *coordinate, electrons, one*

2. ammonium, hidroksonium / *ammonium, hydroxonium*

3. (a) Tiga, berkongsi, kovalen, duplet, oktet
Three, share, covalent, duplet, octet
(b) sepasang, datif, ammonium / *pair, dative, ammonium*

5.6 Ikatan Logam
Metallic Bond

1. dinyahsetempatkan, elektron, logam, ferum, kobalt, kalsium, magnesium
delocalised, electrons, metallic, iron, cobalt, calcium, magnesium

2. elektrik, cas / *electricity, charges*

5.7 Sebatian Ion dan Sebatian Kovalen
Ionic and Covalent Compound

1.

Sebatian ion ***Ionic compound***	**Sebatian kovalen** ***Covalent compound***
(i) Kekonduksian elektrik ***Electrical conductivity***	
Mengkonduksi elektrik dalam keadaan akueus dan leburan *Conducts electricity in aqueous and molten* Sebab: Mempunyai ion yang bebas bergerak *Reason: Has free moving ions*	Tidak mengkonduksi elektrik dalam sebarang keadaan *Does not and conduct electricity in any forms* Sebab: Mempunyai molekul neutral *Reason: Has neutral molecules*
(ii) Keterlarutan dalam air dan pelarut organik ***Solubility in water and organic solvents***	
Larut dalam air, tidak larut dalam pelarut organik *Soluble in water and insoluble organic solvents*	Tidak larut dalam air, larut dalam pelarut organik. *Insoluble in water but dissolve in organic solvents.*
(iii) Takat lebur dan takat didih *Melting point and boiling point*	
Tinggi *High*	Rendah *Low*
Sebab: Daya tarikan elektrostatik antara ion. Banyak haba diperlukan untuk mengatasi daya ini. *Reason Elctrostatics attraction force between ions. More heat is needed to overcome the strong attraction force.*	Sebab: Daya tarikan Van der Waals antara molekul. Sedikit haba diperlukan untuk mengatasi daya ini. *Reason: Van der Waals attraction force between molecules. Less heat is needed to overcome the weak attraction force.*
Contoh *Examples*	
Natrium klorida, magnesium oksida *Sodium chloride, magnesium oxide*	Air, karbon dioksida, naftalena, *Water, carbon dioxide, napthalene,*

Eksperimen 5.1

A Kekonduksian elektrik sebatian
Electrical conductivity of compounds

Hipotesis / *Hypothesis*:

leburan, pepejal, tidak boleh / *molten, solid, does not*

Pemboleh ubah / *Variables*:

(a) Jenis sebatian / *Type of compounds*
(c) Elektrod karbon / *Carbon electrodes*

Keputusan / *Results*:

Sebatian *Compound*	**Keadaan fizikal** *Physical state*	**Mentol menyala** *Bulb lights*
Plumbum(II) bromida *Lead(II) bromide*	Pepejal *Solid*	Tidak *No*
	Leburan *Molten*	Ya *Yes*
Naftalena *Napthalene*	Pepejal *Solid*	Tidak *No*
	Leburan *Molten*	Tidak *No*

B Keterlarutan sebatian di dalam air dan pelarut organik
Solubility of compounds in water and organic solvents

Hipotesis / *Hypothesis*:

larut, larut / *dissolves, dissolves*

Pemboleh ubah / *Variables*:

(a) Jenis sebatian / *Type of compounds*
(c) Isi padu air: pelarut organik / *Volume of water : organic solvent*

Keputusan / *Results*:

Sebatian *Compound*	**Di dalam air** *In water*	**Di dalam sikloheksana** *In cyclohexane*
Magnesium klorida *Magnesium chloride*	Larut *Dissolve*	Tidak larut *Do not dissolve*
Naftalena *Napthalene*	Tidak larut *Do not dissolve*	Larut *Dissolve*

C Takat lebur dan takat didih sebatian
Melting point and boiling point of compounds

Hipotesis / *Hypothesis*:

tinggi, rendah / *high, low*

Pemboleh ubah / *Variables*:

(a) Jenis sebatian / *Type of compounds*
(c) Kukus air / *Water bath*

Keputusan / *Results*:

Sebatian *Compound*	**Pemerhatian** *Observation*	**Inferens** *Inference*
Magnesium klorida *Magnesium chloride*	Pepejal *Solid*	Tidak lebur *Do not melt*
Naftalena *Napthalene*	Cecair *Liquid*	Lebur *Melts*

Perbincangan / *Discussion*:

	Bahan *Substance*	**Inferens** *Inference*
Kekonduksian elektrik *Electrical conductivity*	Leburan plumbum(II) bromida *Molten lead(II) bromide*	Mempunyai ion-ion yang bebas bergerak *Has free-moving ions*
	Serbuk plumbum(II) bromida *Lead(II) bromide powder*	Ion-ion tidak bebas bergerak *Ions are not moving freely*
	Leburan dan serbuk naftalena *Molten and powder naphtalene*	Tiada ion-ion bebas bergerak / Mempunyai molekul neutral *No free moving ions / Has neutral molecules*
Keterlarutan *Solubility*	Magnesium klorida *Magnesium chloride*	Terdiri daripada ion *Has ions*
	Naftalena *Napthalene*	Terdiri daripada molekul *Has molecules*
Takat lebur dan takat didih *Melting point boiling point*	Magnesium klorida *Magnesium chloride*	Daya tarikan elektrostatik yang kuat antara ion. Maka memerlukan banyak tenaga haba untuk mengatasi daya itu. *Strong electrostatic attraction force between ions. Thus, more heat is needed to overcome the attraction force.*
	Naftalena *Napthalene*	Daya tarikan Van der Waals yang lemah antara molekul. Maka memerlukan sedikit tenaga haba untuk mengatasi daya tarikan itu. *Weak Van der Waals attraction force between molecules. Thus, less theat is needed to overcome the attraction force.*

Keputusan / *Results*:

1. ion / *ionic*

2. kovalen / *covalent*

2.

		Sebatian kovalen *Covalent compound*	
		Molekul ringkas *Simple molecule*	**Molekul gergasi** *Giant molecule*
	Struktur *Structure*	Struktur molekul ringkas *Simple molecule structure*	Struktur molekul besar *Large molecule structure*
	Ikatan kimia *Chemical bond*	• Ikatan kovalen yang kuat dalam molekul. *Strong covalent bonds in the molecules* • Daya tarikan Van der Waals yang lemah antara molekul. *Weak Van der Waals attraction forces between molecules*	• Ikatan kovalen yang kuatdalam molekul. *Strong covalent bonds in the molecules* • Tiada tarikan Van der Waals antara molekul. *No Van der Waals attraction forces between molecules*
	Takat lebur dan takat didih *Melting point and boiling point*	*Takat lebur dan takat didih adalah rendah kerana sedikit haba diperlukan untuk memutuskan ikatan Van der Waals yang lemah. Melting point and boiling point are low because only little heat is required to break the weak Van der Waals attraction forces between molecule.*	Takat lebur dan takat didih adalah tinggi kerana banyak haba diperlukan untuk memutuskan ikatan kovalen yang kuat. *Melting point and boiling point are high because a lot of heat is required to break the strong covalent bonds attraction forces between molecules.*

4.

Kegunaan sebatian ion dan sebatian kovalen dalam kehidupan harian.
The uses of ionic and covalent compounds in daily life.

Sektor Perindustrian / *Industrial Sector*

(a) Litium iodida digunakan di dalam bateri.
Lithium iodide is used in battery.

(b) Pigmen dan pelarut turpentin digunakan dalam cat.
Pigment and turpentine solvent are used in paint.

Kegunaan Rumah / *Home Appliances*

(a) Natrium klorat(V) terdapat di dalam detergen.
Sodium chlorate(V) is contained in detergent.

(b) Gliserol ditambah ke dalam produk penjagaan kulit.
Glycerol is added into skincare products.

Sektor Pertanian / *Agricultural Sector*

(a) Ammonium nitrat dan kalium klorida digunakan dalam baja.
Ammonium nitrate and potassium chloride are used in fertiliser.

(b) Bromoetana dan kloropikrin digunakan sebagai racun perosak.
Bromoethane dan Chloropicrin are used in pesticides.

Sektor Perubatan / *Medicine Sector*

(a) Natrium bikarbonat digunakan dalam antasid untuk gastrik.
Sodium bicarbonate is used in antacid for gastric.

(b) Parasetamol digunakan untuk merawat demam atau keradangan.
Paracetamol is used to treat fever or inflammation.

PRAKTIS SPM 5

Soalan Objektif

1. C	**2.** B	**3.** C	**4.** D	**5.** C
6. B	**7.** A	**8.** B	**9.** C	**10.** B

Soalan Struktur

Bahagian A

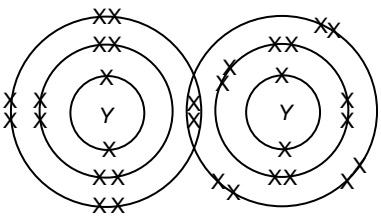
1. (a) Ion / *ionic*

(b) XY_2

(c) (i) 2.8.2

(ii) 2.8.7

(d) (i)



(ii) Kovalen / *Covalent*

Bahagian B

1. (a) Ion / *ionic*

2. (a)

	Ikatan ion *Ionic bonds*	**Ikatan kovalen** *Covalent bonds*
Kesamaan *Similarities*	Mencapai susunan elektron oktet Kedua-dua adalah ikatan *Achieve octet electron arrangement* *Both are bonds*	
Perbezaan *Differences*	Atom logam dan Atom bukan logam *Metal atom and Non- metal atom*	Atom bukan logam dan Atom bukan logam *Non-Metal atom and Non-metal atom*
	Pemindahan elektron *Transfer of electrons*	Perkongsian elektron *Sharing of electrons*
	Zarah : ion *Particles: ions*	Zarah: molekul *Particles: molecules*

(mana-mana dua perbezaan /*any two differences*)

(b) (i) *P*: 2.8
S: 2.1
T: 2.7

(ii) Kumpulan 1

(iii) P. Mempunyai susunan elektron oktet / 8 elektron valens
P. Has octet electron arrangement / 8 valence electrons

(c)

	Sebatian ion *Ionic compound*	**Sebatian kovalen** *Covalent compound*
Keadaan fizikal *Physical properties*	Pepejal *Solid*	Cecair atau gas *Liquid or gas*
Takat lebur & takat didih *Melting point & boiling point*	Tinggi *High*	Rendah *Low*
Kekonduksian elektrik *Electrical conductivity*	Mengkonduksi dalam keadaan leburan / akueus *Conduct in molten / aqueous state*	Tidak konduksi *Do not conduct*
Keterlarutan dalam air / pelarut organik *Solubility in water / organic solvent*	Larut dalam air *Soluble in water*	Tidak larut dalam air *Insoluble in water*
Contoh / *Example*	NaCl	CO_2

BAB 6

Asid , Bes dan Garam
Acid, Base and Salts

6.1 Peranan Air dalam Menunjukkan Keasidan dan Kealkalian
Role of Water in Showing Acidic and Alkaline Properties

1. mengion, ion hidrogen (H^+)
Ionises, hydrogen ion (H^+)

Asid *Acid*	Pengionan dalam air *Ionisation in water*
(i) HCl Hidrogen klorida *Hydrogen chloride*	$HCl(ak) \xrightarrow{H_2O} \underline{H^+(ak) + Cl^-(ak)}$
(ii) HNO_3 Asid nitrik *Nitric acid*	$HNO_3(ak) \xrightarrow{H_2O} \underline{H^+(ak) + NO_3^-(ak)}$
(iii) H_2SO_4 Asid sulfurik *Sulphuric acid*	$H_2SO_4(ak) \xrightarrow{H_2O} \underline{2H^+(ak) + SO_4^{2-}(ak)}$
(iv) CH_3COOH Asid etanoik *Ethanoic acid*	$CH_3COOH(ak) \overset{H_2O}{\rightleftharpoons} \underline{H^+(ak) + CH_3COO^-(ak)}$

2. ion hidroksonium, (H_3O^+) / *hydroxonium ion, (H_3O^+)*
$H^+ + H_2O \longrightarrow H_3O^+$

3. ion hidrogen, H^+ / *hydrogen ions, H^+*
(a) air, 1 / *water, 1*
(b) air, 2 / *water, 2*
(c) air, 3 / *water, 3*

4. asid, garam, air / *acid, salt, water*
(a) $MgO(ak) + 2HCl(ak) \rightarrow MgCl_2(ak) + H_2O(ce)$
$CaCOH_2(ak) + 2HCl(ak) \rightarrow CaCl_2(ak) + H_2O(ce)$
(b) zink oksida, zink hidroksida / *zinc oxide, zinc hydroxide*
(c) natrium oksida, kalium hidroksida / *sodium oxide, potassium hydroxide*

5. mengion, ion hidroksida, OH^- / *ionises, hydroxide ion, OH^-*

Alkali *Alkali*	Pengionan dalam air *Ionisation in water*
(i) NaOH Natrium hidroksida *Sodium hydroxide*	$NaOH \xrightarrow{H_2O} Na^+ + OH^-$
(ii) KOH Kalium hidroksida *Potassium hydroxide*	$KOH \xrightarrow{H_2O} K^+ + OH^-$
(iii) NH_3 Ammonia *Ammonia*	$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

6. (a) mengion, hidrogen, H^+, hidroksonium, H_3O^+ / *ionise, hydrogen, H^+, hydroxonium, H_3O^+*
(b) mengion, hidroksida / *ionises, hydroxide*

Eksperimen 6.1

Hipotesis / *Hypothesis*:

Air, asid / *Water, acid*

Pemboleh ubah / *Variables*:

(a) Kehadiran air / *Presence of water*
(c) Jenis asid / *Type of acid*

Keputusan / *Results*:

Bahan ***Substance***	**Pemerhatian** ***Observation***	**Inferens** ***Inference***
Pepejal asid oksalik *Oxalic acid solid*	Tiada perubahan *No changes*	Bukan asid *Not acid*
Asid oksalik + air *Oxalic acid + water*	Biru ke merah *Blue to red*	Asid *Acid*

Perbincangan / *Discussions*:

1. air, hidrogen / *water, hydrogen*
2. molekul, hidrogen / *molecule, hydrogen*

Keputusan / *Conclussion*:

1. air, hidrogen / *water, hydrogen*
2. diterima / *accepted*

Eksperimen 6.2

Hipotesis / *Hypothesis*:

Air, alkali / *Water, alkali*

Pemboleh ubah / *Variables*:

(a) Kehadiran air / *Presence of water*
(c) Jenis alkali / *Type of alkali*

Keputusan / *Results*:

Bahan ***Substance***	**Pemerhatian** ***Observation***	**Inferens** ***Inference***
Pelet natrium hidroksida *Sodium hydroxide pellets*	Tiada perubahan *No changes*	Bukan alkali *Not alkali*
Natrium hidroksida + air *Sodium hydroxide + water*	Merah ke biru *Red to blue*	Alkali *Alkali*

Perbincangan / *Discussions*:

1. air, hidroksida / *water, hydroxide*
2. tidak / *not*

Keputusan / *Conclussion*:

1. air, hidroksida / *water, hydrogen*
2. diterima / *accepted*

6.2 Nilai pH
pH Values

1. hidrogen / *hydrogen*

2. keasidan, kealkalian
Acidity, alkalinity

Eksperimen 6.3

Hipotesis / *Hypothesis*:

tinggi, rendah / *higher, lower*

Pemboleh ubah / *Variables*:

(a) Kepekatan ion H^+ / *Concentration of H^+ ion*
(c) Jenis asid / *Type of acid*

Keputusan / *Results*:

Kepekatan (mol dm^{-3}) *Concentration (mol dm^{-3})*	0.1	0.01	0.001
Nilai pH *pH value*	1	2	3

Perbincangan / *Discussions*:

1. hidrogen / *hidrogen*
2. berkurang / *decreases*

Keputusan / *Conclussion*:

1. Kepekatan, tinggi, rendah, / *concentration, higher, lower*
2. diterima / *accepted*

Eksperimen 6.4

Hipotesis / *Hypothesis*:

tinggi, tinggi / *higher, higher*

Pemboleh ubah / *Variables*:

(a) Kepekatan ion OH^- / *Concentration of OH^- ion*
(c) Jenis alkali / *Type of alkali*

Keputusan / *Results*:

Kepekatan (mol dm^{-3}) *Concentration (mol dm^{-3})*	0.1	0.01	0.001
Nilai pH *pH value*	13	11	10

Perbincangan / *Discussions*:

1. hidroksida / *hidroxide*
2. bertambah / *decreases*

Keputusan / *Conclussion*:

1. Kepekatan, tinggi, tinggi, / *concentration, higher, higher*
2. diterima / *accepted*

6.3 Kekuatan Asid dan Alkali
Strength of Acid and Alkali

1. lengkap, tinggi / *completely, high*
Contoh / *Example*
tinggi, hidrogen, rendah / *high, hydrogen, low*

2. separa, rendah / *partially, low*
Contoh / *Example*
rendah, hidrogen, tinggi / *low, hydrogen, high*

3. lengkap, tinggi / *completely, high*
Contoh / *Example*
tinggi, hidroksida, tinggi / *high, hydroxide, high*

4. separa, rendah / *partially, low*
Contoh / *Example*
rendah, hidroksida, rendah / *low, hydroxide, low*

6.4 Sifat-sifat Kimia Asid dan Alkali
Chemical properties of Acid and Alkali

Aktiviti 6.1

A garam, air, peneutralan / *salt, water, neutralisation*

Prosedur / *Procedure*:

6.

Pemerhatian *Observation*	• Pepejal hitam larut dan membentuk larutan biru. *Black solid dissolves and forms blue solution.* • Hablur berwarna biru terbentuk. *Blue crystals are formed.*
Persamaan kimia *Chemical equation*	$CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$

B garam, gas hidrogen / *salt, hydrogen gas*

Prosedur / *Procedure*:

10.	**Pemerhatian** *Observation*	• Serbuk zink larut dan membentuk larutan tak berwarna. *Zinc powder is dissolved and formed colourless solution.* • Hablur berwarna putih terbentuk. *White crystals are formed.* • Gas tak berwarna dan bunyi 'pop' terhasil. *Colourless gas and 'pop'sound are produced.*
	Persamaan kimia *Chemical equation*	$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

C garam, gas karbon dioksida, air / *salt, carbon dioxide gas, water*

Prosedur / *Procedure*:

3.	**Pemerhatian** *Observation*	• Serbuk putih larut dan membentuk larutan tak berwarna. *White powder is dissolved and formed colourless solution.* • Hablur berwarna putih terbentuk. *White crystals are formed.* • Gelembung gas tak berwarna terhasil dan air kapur menjadi keruh. *Colourless gas is produced and turns limewater chalky.*
	Persamaan kimia *Chemical equation*	$CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$

Aktiviti 6.2

A garam, air / *salt, water*

Prosedur / *Procedure*:

6.	**Pemerhatian** *Observation*	• Serbuk putih larut dan membentuk larutan tak berwarna. *White powder is dissolved and formed colourless solution.* • Hablur berwarna putih terbentuk. *White crystals are formed.*
	Persamaan kimia *Chemical equation*	$NaOH + C_6H_5COOH \longrightarrow C_6H_5COONa + H_2O$

B garam, air, gas ammonia / *salt, water, ammonia gas*

Prosedur / *Procedure*:

4.	**Pemerhatian** *Observation*	• Larutan tak berwarna terbentuk. *Colourless solution is formed.* • Gas tidak berwarna dan berbau sengit terhasil. *Colourless gas with pungent smell is produced.* • Kertas litmus merah menjadi biru . *Red litmus paper turns blue .*
	Persamaan kimia *Chemical equation*	$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3$

C tak larut, kation / *insoluble, cation*

Prosedur / *Procedure*:

3.	**Pemerhatian** *Observation*	Mendakan biru terbentuk. *Blue precipitate is formed.*
	Persamaan kimia *Chemical equation*	$Cu^{2+} + 2NaOH \longrightarrow Cu(OH)_2 + 2Na^+$

Tugasan 2

1.

Bahan *Substance*	Uji dengan kertas litmus *Test with litmus paper*	
	Kertas litmus biru *Blue litmus paper*	Kertas litmus merah *Red litmus paper*
Larutan kalium hidroksida *Potassium hydroxide solution*	✓	Biru *Blue*
Asid etanoik *Ethanoic acid*	Merah *Red*	✓
Asid etanoik glasial *Glacial ethanoic acid*	✓	✓
Ammonia akueus *Aqueous ammonia*	✓	Biru *Blue*
Asid sulfurik *Sulphuric acid*	Merah *Red*	✓
Asid hidroklorik kering *Dry hydrochloric acid*	✓	✓
Asid propanoik dalam propanon *Propanoic acid in propanone*	✓	✓
Air kapur *Limewater*	✓	Biru *Blue*
Pepejal natrium hidroksida *Sodium hydroxide solid*	✓	✓

2.

Bahan tindak balas *Reactants*	Persamaan kimia *Chemical equation*
Asid hidroklorik dan zink oksida *Hydrochloric acid and zinc oxide*	$2HCl + Zn \longrightarrow ZnCl_2 + H_2O$
Asid sulfurik dan larutan kalium hidroksida *Sulphuric acid and potassium hydroxide solution*	$H_2SO_4 + 2KOH \longrightarrow Na_2SO_4 + 2H_2O$
Asid nitrik dan magnesium *Nitric acid and magnesium*	$2HNO_3 + Mg \longrightarrow Mg(NO_3)_2 + H_2O$
Ammonia akueus dan asid hidroklorik *Aqueous ammonia and hydrochloric acid*	$NH_3 + HCl \longrightarrow NH_4Cl$
Asid sulfurik dan zink karbonat *Sulphuric acid and zinc carbonate*	$H_2SO_4 + ZnCO_3 \longrightarrow ZnSO_4 + CO_2 + H_2O$
Asid etanoik dan magnesium *Ethanoic acid and magnesium*	$2CH_3COOH + Mg \longrightarrow Mg(CH_3COO)_2 + H_2$
Asid nitrik dan plumbum(II) oksida *Nitric acid and lead(II) oxide*	$2HNO_3 + PbO \longrightarrow Pb(NO_3)_2 + H_2O$

6.5 Kepekatan Larutan Akueus
Concentration of Aqueous Solution

1. natrium hidroksida, air / *sodium hydroxide, water*

2. (a) kuantiti, isi padu / *quantity, volume*
(b) g dm^{-3}
(c) mol, 1 dm^3, mol dm^{-3} / *mol, 1 dm^3, mol dm^{-3}*

3. $n\text{KOH} = \frac{5}{39 + 16 + 1}$

$= \frac{5}{56}$

$n = \frac{MV}{1000}$

$\frac{5}{56} = \frac{M \times 500}{1000}$

$= 0.18 \text{ mol dm}^{-3}$

Tugasan 3

1. (a)

$4Na + O_2 \longrightarrow 2Na_2O$

$4Na : 2Na_2O$
$2 : 1$
$0.2 : 0.1$

$n \text{ Na} = \frac{4.6}{23}$
$= 0.2$

$Na_2O + H_2O \longrightarrow 2NaOH$

$Na_2O : 2NaOH$
$0.1 : 0.2$

$n = \frac{MV}{1000}$

$M = \frac{n \times 1000}{V}$

Kemolaran NaOH, *Molarity* $M = \frac{0.2 \times 1000}{500}$

$M = 0.4 \text{ mol dm}^{-3}$

(b) (i)

Isi padu *Volume* $= \frac{100}{1000}$
$= 0.1 \text{ dm}^3$

Kepekatan / *Concentration* $= \frac{8.5}{0.1}$
$= 85 \text{ g dm}^{-3}$

(ii)

Kemolaran *Molarity* $= \frac{85}{85} \text{ mol dm}^{-3}$
$= 1.0 \text{ mol dm}^{-3}$

6.6 Larutan Piawai
Standard Solution

1. kepekatannya / *concentration*

2. 1. $0.25 \times 100 = 250$ g
3. air suling / *distilled water*
4. kelalang volumetrik, corong turas, air suling
volumetric flask, filter funnel, distilled water
5. tanda senggatan / *calibrated mark*
6. digoncang, ditelangkupkan / *shaken, inverted*

3. 2. kelalang volumetrik / *volumetric flask*
3. tanda senggatan / *calibrated mark*
4. penutup, digoncang, ditelangkupkan / *stopper, shaken, inverted*

4. $n = \frac{MV}{1000}$, maka / *so*, $M = \frac{1000 \times 0.5}{500}$

$M = \frac{1000 \times n}{V}$

$M = 1.0 \text{ mol dm}^{-3}$

6.7 Peneutralan
Neutralisation

1. asid, alkali, garam, air / *acid, alkali, salt, water*

Persamaan kimia *Chemical equation*	**Persamaan ion** *Ion equation*
$HCl + NaOH \longrightarrow NaCl + H_2O$	$H^+ + OH^- \longrightarrow H_2O$
$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$	$H^+ + OH^- \longrightarrow H_2O$
$HNO_3 + NaOH \longrightarrow NaNO_3 + H_2O$	$H^+ + OH^- \longrightarrow H_2O$

2. hidrogen, hidroksida, air / *hydrogen, hydroxide, water*

3. (a) buret, kelalang kon / *burette, conical flask, indicator*
(b) takat akhir, warna / *end point, colour*

(c)

Penunjuk *Indicator*	**Warna penunjuk dalam larutan** *Colour of indicator in solution*		
	Asid *Acid*	**Alkali** *Alkali*	**Neutral** *Neutral*
Fenolftalein *Phenolphthalein*	Tidak berwarna *Colourless*	Merah jambu *Pink*	Tidak berwarna *Colourless*
Metil jingga *Methyl orange*	Merah *Red*	Kuning *Yellow*	Jingga *Orange*

4. (a) $H_2SO_4 + 2KOH \longrightarrow K_2SO_4 + 2H_2O$

$$n\text{KOH} = \frac{MV}{1000}$$
$$= \frac{1 \times 25}{1000} = 0.025$$

H_2SO_4 : 2KOH
1 mol : 2 mol
0.0125 : 0.025

Isi padu asid sulfurik / *Volume of sulphuric acid* $= \frac{0.0125 \times 1000}{0.5}$
$= 25\ \text{cm}^3$

(b) (i) $H_2SO_4 + 2KOH \longrightarrow K_2SO_4 + 2H_2O$

(ii) Purata isi padu asid hidroklorik / *Average volume of hydrochloric acid* $= \frac{9.90 + 10.00 + 10.1}{3}$
$= 10.00\ \text{cm}^3$

(iii)

H_2SO_4	:	2KOH
1 mol		2 mol
$n = \frac{1.0 \times 10}{1000}$		
$= 0.01$		0.02

Kemolaran bagi KOH / *Molarity for KOH* $= \frac{0.02 \times 1000}{25}$
$= 0.8\ \text{mol dm}^{-3}$

6.8 Garam, Hablur dan Kegunaan dalam Kehidupan Harian
Salts, Crystals and Uses in Everyday Lifes

1. hidrogen, H^+, logam, ammonium, NH_4^+ / *hydrogen, H^+, metal, ammonium, NH_4^+*

2. kation, ammonia, anion, asid / *kation, ammonia, anion, acid*

3. (a) tetap / *Fixed*
(b) Sudut / *angles*
(c) bentuk geometri, saiz / *geometrical shape, sizes*
(d) rata, tajam / *Flat, sharp*

4.

Kegunaan *Uses*	**Contoh dan nama garam** *Examples and names of salt*	
Pertanian *Agriculture*	(i) Sebagai baja : ammonium nitrat *As fertilisers: ammonium nitrate*	(ii) Sebagai racun serangga: iron(II) sulfat *As pesticides: iron(II) sulphate*
Perubatan *Medicine*	(i) Sebagai plaster: kalsium sulfat *As plaster: calcium sulphate*	(ii) Sebagai ubat antiseptik: kalium manganate(VII) *As antiseptic: potassium manganate(VII)*
Penyediaan makanan *Food preparation*	(i) Sebagai perisa: natrium klorida *As flavouring: sodium chloride*	(ii) Penaik adunan : natrium bikarbonat *As raising dough: sodium bicarbonate*
Pengawet *Preservation*	(i) Pengawet sos: natrium benzoate *Sauce preservative: sodium benzoate*	(ii) Pengawet daging proses: natrium nitrat *Preserved processed meat: sodium nitrate*

Tugasan 4

1.

Ion logam *Metal ion*	**Garam sulfat** *Sulphate salt* **(dari / *from* H_2SO_4)**	**Garam klorida** *Chloride salt* **(dari / *from* HCl)**	**Garam nitrat** *Nitrate salt* **(dari / *from* HNO_3)**	**Garam karbonat** *Carbonate salt* **(dari / *from* H_2CO_3)**
K^+	K_2SO_4	KCl	KNO_3	K_2CO_3
Na^+	Na_2SO_4	NaCl	$NaNO_3$	Na_2CO_3
Ca^{2+}	$CaSO_4$	$CaCl_2$	$Ca(NO_3)_2$	$CaCO_3$
Mg^{2+}	$MgSO_4$	$MgCl_2$	$Mg(NO_3)_2$	$MgCO_3$
Al^{3+}	$Al_2(SO_4)_3$	$AlCl_3$	$Al(NO_3)_3$	$Al_2(CO_3)_3$
Zn^{2+}	$ZnSO_4$	$ZnCl_2$	$Zn(NO_3)_2$	$ZnCO_3$
Fe^{2+}	$FeSO_4$	$FeCl_2$	$Fe(NO_3)_2$	$FeCO_3$
Pb^{2+}	$PbSO_4$	$PbCl_2$	$Pb(NO_3)_2$	$PbCO_3$
Cu^{2+}	$CuSO_4$	$CuCl_2$	$Cu(NO_3)_2$	$CuCO_3$
Ag^+	Ag_2SO_4	AgCl	$AgNO_3$	Ag_2CO_3
Ba^{2+}	$BaSO_4$	$BaCl_2$	$Ba(NO_3)_2$	$BaCO_3$
NH_4^+	$(NH_4)_2SO_4$	NH_4Cl	NH_4NO_3	$(NH_4)_2CO_3$

2.

	Persamaan kimia *Chemical equation*
(a)	$MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$
(b)	$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$
(c)	$MgCO_3 + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2O + CO_2$
(d)	$Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$
(e)	$HCl + NaOH \longrightarrow NaCl + H_2O$

6.9 Penyediaan Garam
Preparation of Salts

1. (a) terlarutkan / *Soluble ;* tak terlarutkan / *Insoluble*

Eksperimen 6.5

Hipotesis / *Hypothesis*:

larut, tidak larut / *dissolve, do not*

Pemboleh ubah / *Variables*:

(a) Jenis garam nitrat, sulfat, klorida, karbonat dan ammonium
Types of nitrate, sulphate, chloride, carbonate and ammonium salts

(c) Isi padu air / Suhu air / Jisim garam
Volume of water / Temperature of water / Mass of salt

Keputusan / *Results*:

Garam *Salt*	NaCl	$PbCl_2$	$ZnCO_3$	K_2CO_3	NH_4NO_3	$BaSO_4$	$MgSO_4$
Keterlarutan *Solubility*	Larut *Soluble*	Tidak larut *Insoluble*	Tidak larut *Insoluble*	Larut *Soluble*	Larut *Soluble*	Tidak larut *Insoluble*	Larut *Soluble*

Garam *Salt*	AgCl	$CuCO_3$	$CaSO_4$	$PbSO_4$
Keterlarutan *Solubility*	Tidak larut *Insoluble*	Tidak larut *Insoluble*	Tidak larut *Insoluble*	Tidak larut *Insoluble*

Perbincangan / *Discussions*:

1. natrium, kalium / *Sodium, potassium*

2. Zink karbonat, kuprum(II) karbonat / *Zinc carbonate, copper(II) carbonate*

3. Barium sulfat, kalsium sulfat / *Barium sulphate, calcium sulphate*

4. Plumbum(II) klorida, argentum klorida / *Lead (II) chloride, silver chloride*

Keputusan / *Conclussion*:

1. larut, tidak larut / *dissolve, do not*

Kaedah Penyediaan Garam:

Methods of Salts Preparation:

A (a) peneutralan / *Neutralisation*
Pentitratan / *Titration*
Asid + Alkali : Garam + Air
Acid + Alkali : Salt + water
$HCl + NaOH : NaCl + H_2O$
$H_2SO_4 + 2KOH : K_2SO_4 + H_2O$

(b) (i) Asid + Oksida logam ⟶ Garam + Air
Acid + Metal oxide ⟶ Salt + Water
$2HCl + MgO \longrightarrow MgCl_2 + H_2O$
$2HNO_3 + ZnO \longrightarrow Zn(NO_3)_2 + H_2O$

(ii) Asid + Logam ⟶ Garam + Gas hidrogen
Acid + Metal ⟶ Salt + Hydrogen gas
$2HCl + Mg \longrightarrow MgCl_2 + H_2$
$2HNO_3 + Zn \longrightarrow Zn(NO_3)_2 + H_2$

(iii) Asid + Logam karbonat ⟶ Garam + Gas karbon dioksida + Air
Acid + Metal carbonate ⟶ Salt + Carbon dioxide gas + Water
$2HCl + CaCO_3 \longrightarrow CaCl_2 + CO_2 + H_2O$
$H_2SO_4 + CuCO_3 \longrightarrow CuSO_4 + CO_2 + H_2O$

B **1.** penguraian ganda dua / *double decomposition*

2. terlarut, garam tak terlarutkan, garam terlarutkan
soluble, insoluble salt, soluble salt

Penyediaan garam terlarutkan (selain Na^+, K^+, NH^{4+})

Preparation of soluble salt (except Na^+, K^+, NH^{4+})

1 (a) silinder penyukat / *measuring cylinder*
(b) Serbuk, dipanaskan / *powder, heated*
(c) dikacau / *stirred*
(d) berlebihan, asid / *excess, acid*

2 dituraskan / *filtered*

3 mangkuk pijar, tepu / *crucible, saturated*

4 (a) hablur garam / *salt crystals*
(b) dituraskan, air suling / *filtered, distilled water*

5 dikeringkan, kertas turas / *is dried, papers*

A (a) silinder penyukat, kelalang kon / *measuring cylinder, conical flask*
(c) dititratkan / *is titrated*
(d) asid / *acid*
(e) tanpa, neutral / *without, neutral*

Contoh (a) / *Example (a)*

Bahan *Substance*	**Pemerhatian** *Observation*
Asid nitrik + kuprum(II)oksida *Nitric acid + copper(II) oxide*	Serbuk kuprum(II) oksida larut menghasilkan larutan biru. *Copper(II) oxide is dissolved producing a blue solution.*
Asid nitrik + kuprum(II) karbonat *Nitric acid + copper(II) carbonate*	Serbuk kuprum(II) karbonat larut menghasilkan larutan biru. *Copper(II) carbonate dissolve producing a blue solution.* Gelembung gas terhasil. *Bubbles of gas is produced*

Persamaan kimia *Chemical equation*
$HNO_3 + CuO \longrightarrow Cu(NO_3)_2 + H_2O$
$HNO_3 + CuCO_3 \longrightarrow Cu(NO_3)_2 + CO_2 + H_2O$

Contoh (b) / *Example (b)*

Bahan *Substance*	**Pemerhatian** *Observation*
Asid sulfurik + zink *Sulphuric acid + zinc*	Serbuk zink larut menghasilkan larutan tidak berwarna *Zinc powder dissolve producing a colourless solution.* Gelembung gas terhasil *Bubbles of gas produced*
Asid sulfurik + zink oksida *Sulphuric acid + zinc oxide*	Serbuk zink larut menghasilkan larutan tidak berwarna *Zinc powder dissolve producing a colourless solution.*
Asid sulfurik + zink karbonat *Sulphuric acid +zinc carbonate*	Serbuk zink larut menghasilkan larutan tidak berwarna *Zinc powder dissolve producing a colourless solution.* Gelembung gas terhasil *Bubbles of gas produced*

Persamaan kimia *Chemical equation*
$H_2SO_4 + Zn \longrightarrow ZnSO_4 + H_2$
$H_2SO_4 + ZnO \longrightarrow ZnSO_4 + H_2O$
$H_2SO_4 + ZnCO_3 \longrightarrow ZnSO_4 + CO_2 + H_2O$

Penyediaan Garam Tak Terlarutkan, Barium Sulfat, $BaSO_4$
Preparation of An Insoluble Salt, $BaSO_4$

1.

Pemerhatian *Observation*	**Mendakan putih** *White precipitate*
Inferens *Inference*	Garam tak terlarutkan ialah barium sulfat *Insoluble salt is barium sulphate*
Persamaan kimia *Chemical equation*	$BaCl_2 + Na_2SO_4 \longrightarrow Ba\ SO_4 + 2NaCl$
Persamaan ion *Ionic equation*	$Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4$

Eksperimen 6.6

Hipotesis / *Hypothesis*:

bertambah, bertambah / *higher, higher*

Pemboleh ubah / *Variables*:

(a) Isi padu larutan kalium iodida / *Volume of potassium iodide solution*

(c) Isi padu dan kepekatan larutan plumbum(II) nitrat, kepekatan larutan kalium iodida
Volume and concentration of lead(II) nitrate, concentration of potassium iodide

Keputusan / *Result*:

Tabung uji *Tabung uji*	1	2	3	4	5	6	7
Isi padu plumbum(II) nitrat, $Pb(NO_3)_2$ (cm^3) *Volume of lead(II) nitrate, $Pb(NO_3)_2$ (cm^3)*	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Isi padu kalium iodida, KI (cm^3) *Volume of potassium iodide, KI (cm^3)*	1.00	2.00	3.00	4.00	5.00	6.00	7.00
Height of precipitate (cm) *Ketinggian mendakan (cm)*	0.6	1.2	1.8	2.4	3.0	3.0	3.0

Perbincangan / *Discussion*:

1. Bilangan mol larutan KI, $n = \frac{5 \times 1.0}{1000}$, $n = 0.005$ mol
Number of moles KI solution

Bilangan mol larutan $Pb(NO_3)_2$, $n = \frac{5 \times 0.5}{1000}$, $n = 0.0025$ mol
Number of moles $Pb(NO_3)_2$ solution

Nisbah mol / *Mole ratio*, $\frac{0.0025}{0.0025}\ Pb^{2+} : \frac{0.005}{0.0025}\ I^-$

maka / *thus*,

$1\ mol\ Pb^{2+} : 2\ mol\ I^-$

2. 1, 2, 1 / *1, 2, 1*

Kesimpulan / *Conclusion*:

1. perubahan berterusan / *continuous variation*

2. $Pb^{2+} + 2I^- \longrightarrow PbI_2$

6.10 Tindakan Haba ke atas Garam
Effect of Heat on Salts

1. gas, asid / *gas, acid*

2.

Gas *Gas*	Kaedah *Method*	Pemerhatian *Observation*
(i) Oksigen, O_2 *Oxygen, O_2* • tidak berwarna, neutral *colourless, neutral*	Kayu uji berbara dimasukkan ke dalam tabung uji. *A glowing wooden splinter is put into the test tube.*	Kayu uji menyala. *Wooden splinter lights up.*
(ii) Hidrogen, H_2 *Hydrogen, H_2* • tidak berwarna, neutral *colourless, neutral*	Kayu uji bernyala dimasukkan ke dalam tabung uji. *A lighted wooden splinter is put into the test tube.*	Bunyi 'pop' terhasil. *'Pop' sound produced.*
(iii) Karbon dioksida, CO_2 *Carbon dioxide, CO_2* • tidak berwarna, berasid *colourless, acidic*	Gas dialirkan ke dalam air kapur di dalam tabung uji. *The gas is flowed into limewater in a test tube.*	Air kapur menjadi keruh. *Limewater becomes cloudy.*
(iv) Ammonia, NH_3 *Ammonia, NH_3* • tidak berwarna, alkali, berbau sengit *colourless, alkali, pungent smell*	Kertas litmus merah lembap didekatkan ke mulut tabung uji. *A moist red litmus paper is placed to the mouth fo the test tube.*	Kertas litmus merah lembap menjadi biru. *Moist red litmus paper turns blue.*
(v) Klorin, CI_2 *Chlorine, CI_2* • gas kuning kehijauan, berasid dan peluntur *yellow greenish gas, acidic and bleaching*	Kertas litmus biru lembap didekatkan ke mulut tabung uji. *A moist blue litmus paper is put to the mouth of the test tube.*	Kertas litmus biru lembab menjadi merah dan kemudian putih. *Moist red litmus paper turns blue and then white.*
(vi) Hidrogen klorida, HCI *Hydrogen chloride, HCI* • tidak berwarna, berasid *colourless, acidic*	Rod kaca yang dicelup dengan larutan ammonia pekat didekatkan pada mulut tabung uji. *A glass rod dipped in concentrated ammonia solution is placed to the mouth of the test tube.*	Wasap putih terhasil. *White fumes produced.*
(vii) Sulfur dioksida, SO_2 *Sulphur dioxide, So_2* • tidak berwarna, berasid, berbau sengit *colourless, acidic, pungent smell*	Gas dialirkan ke dalam larutan kalium manganat(VII) berasid di dalam tabung uji. *The gas is flowed into acidified potassium manganate(VII) solution in a test tube.*	Warna ungu larutan kalium manganat(VII) berasid menjadi tidak berwarna. *Purple colour of acidified potassium manganate(VII) solution turns colourless.*
(viii) Nitrogen dioksida, NO_2 *Nitrogen dioxide, NO_2* • gas perang, berasid, berbau sengit *brown gas, acidic, pungent smell*	Kertas litmus biru lembap didekatkan ke mulut tabung uji. *A moist blue litmus paper is placed to the mouth of the test tube.*	Kertas litmus biru lembap menjadi merah. *Moist blue litmus paper turns red.*

3.

Oksida logam *Metal oxide*	**Panas** ***Hot***	**Sejuk** ***Cold***
Zink oksida / *Zinc oxide*	Kuning / *Yellow*	Putih / *White*
Plumbum(II) oksida / *Lead(II) oxide*	Perang / *Brown*	Kuning / *Yellow*
Kuprum(II) oksida / *Copper(II) oxide*	Hitam / *Black*	Hitam / *Black*
Besi(III) oksida / *Iron(III) oxide*	Perang / *Brown*	Perang / *Brown*
Magnesium oksida / *Magnesium oxide*	Putih / *White*	Putih / *White*

4. (a)

Garam karbonat ***Carbonate salt***	**Persamaan kimia** ***Chemical equation***
Kuprum(II) karbonat *Copper(II) carbonate*	$CuCO_3 \longrightarrow \underline{CuO} + CO_2$
Plumbum(II) karbonat *Lead(II) carbonate*	$PbCO_3 \longrightarrow \underline{PbO} + CO_2$
Zink karbonat *Zinc carbonate*	$ZnCO_3 \longrightarrow \underline{ZnO} + CO_2$
Kalsium karbonat *Calcium carbonate*	$CaCO_3 \longrightarrow \underline{CaO} + CO_2$

Garam nitrat ***Nitrate salt***	**Persamaan kimia** ***Chemical equation***
Kuprum(II) nitrat *Copper(II) nitrate*	$2Cu(NO_3)_2 \longrightarrow \underline{2CuO} + 4NO_2 + O_2$
Plumbum(II) nitrat *Lead(II) nitrate*	$2Pb(NO_3)_2 \longrightarrow \underline{2PbO} + \underline{4NO} + O_2$
Zink nitrat *Zinc nitrate*	$2Zn(NO_3)_2 \longrightarrow 2ZnO + 4NO_2 + \underline{O_2}$
Kalsium nitrat *Calcium nitrate*	$2Ca(NO_3)_2 \longrightarrow 2CaO + 4NO_2 + \underline{O_2}$

Eksperimen 6.7

Keputusan / *Result*:

Garam karbonat ***Carbonate salt***	**Warna garam sebelum dipanaskan** ***Colour of salt before heating***	**Warna baki** ***Colour of residue***		**Kesan ke atas air kapur** ***Effect on limewater***
		Panas ***Hot***	**Sejuk** ***Cool***	
Zink karbonat, $ZnCO_3$ *Zinc carbonate. $ZnCO_3$*	Putih *White*	Kuning *Yellow*	Putih *White*	Keruh *Cloudy*
Plumbum karbonat, $PbCO_3$ *Lead(II) carbonate, $PbCO_3$*	Putih *White*	Perang *Brown*	Kuning *Yellow*	Keruh *Cloudy*
Kuprum(II) karbonat, $CuCO_3$ *Copper(II) carbonate, $CuCO_3$*	Hijau *Green*	Hitam *Black*	Hitam *Black*	Keruh *Cloudy*
Kalsium karbonat, $CaCO_3$ *Calcium carbonate, $CaCO_3$*	Putih *White*	Putih *White*	Putih *White*	Keruh *Cloudy*
Natrium karbonat, Na_2CO_3 *Sodium carbonate, Na_2CO_3*	Putih *White*	–	–	Tiada perubahan *No changes*

Perbincangan / *Discussion*:

1. karbon dioksida / *carbon dioxide*

2. terurai / *decomposed*

Kesimpulan / *Conclusion*:

logam oksida, karbon dioksida / *metal oxides, carbon dioxide*

Eksperimen 6.8

Keputusan / *Result*:

Garam karbonat *Carbonate salt*	**Warna garam sebelum dipanaskan** *Colour of salt before heating*	**Warna baki** *Colour of residue*		**Ujian gas** *Gas tests*		
		Panas *Hot*	**Sejuk** *Cool*	**Warna gas** *Gas colour*	**Kayu uji berbara** *Glowing wooden splinter*	**Kertas litmus biru** *Blue litmus paper*
Zink nitrat, $Zn(NO_3)_2$ *Zinc nitrate, $Zn(NO_3)_2$*	Putih *White*	Kuning *Yellow*	Putih *White*	Gas perang dan gas tidak berwarna *Brown gas and colourless gas*	Menyala *Rekindles*	Bertukar merah *Turns red*
Plumbum(II) nitrat, $Pb(NO_3)_2$ *Lead(II) nitrate, $Pb(NO_3)_2$*	Putih *White*	Perang *Brown*	Kuning *Yellow*	Gas perang dan gas tidak berwarna *Brown gas and colourless gas*	Menyala *Rekindles*	Bertukar merah *Turns red*
Kuprum(II) nitrat, $Cu(NO_3)_2$ *Copper(II) nitrate, $Cu(NO_3)_2$*	Biru *Blue*	Hitam *Black*	Hitam *Black*	Gas perang dan gas tidak berwarna *Brown gas and colourless gas*	Menyala *Rekindles*	Bertukar merah *Turns red*
Kalsium nitrat, $Ca(NO_3)_2$ *Calcium nitrate, $Ca(NO_3)_2$*	Putih *White*	Putih *White*	Putih *White*	Gas perang dan gas tidak berwarna *Brown gas and colourless gas*	Menyala *Rekindles*	Bertukar merah *Turns red*
Natrium nitrat, $NaNO_3$ *Sodium nitrate, $NaNO_3$*	Putih *White*	Putih *White*	Putih *White*	Gas tidak berwarna *Colourless gas*	Menyala *Rekindles*	Kekal biru *Remains blue*

Perbincangan / *Discussion*:

1. oksigen, nitrogen dioksida / *oxygen, nitrogen dioxide*

2. oksigen / *oxygen*

Kesimpulan / *Conclusion*:

logam oksida, nitrogen dioksida, oksigen / *metal oxides, nitrogen dioxide, oxygen*

6.11 Analisis Kualitatif
Qualitative Analysis

1. kation, anion / *cation, anion*

Langkah 1: Pemerhatian terhadap Sifat-sifat Fizik Garam
Step 1 : Observations on the Physical Properties of Salts

(a)

Pepejal *Solid*	Larutan *Solution*	Garam / Oksida logam *Salt / Metal oxide*
(i) Putih / *White*	Tak berwarna *Colourless*	Na^+, Ca^{2+}, Mg^{2+}, Al^{3+}, Zn^{2+}, K^+, Pb^{2+}, NH_4^+, Cl^-, SO_4^{2-}, CO_3^{2-}, NO_3^-
(ii) Biru / *Blue*	Biru / *Blue*	$CuSO_4$, $Cu(NO_3)_2$
(iii) Hijau / *Green*	Biru / *Blue*	$CuCl_2$
(iv) Hijau / *Green*	Tak larut / *Insoluble*	$CuCO_3$
(v) Hijau / *Green*	Hijau / Hijau muda *Green / Light green*	Fe^{2+}
(vi) Perang / *Brown*	Perang / Perang kekuningan *Brown / Yellowish brown*	Fe^{3+}
(vii) Hitam / *Black*	Tak larut / *Insoluble*	CuO
(viii) Kuning(panas), putih(sejuk) *Yellow(hot), white(cold)*	Tak larut / *Insoluble*	ZnO
(ix) Perang(panas), kuning(sejuk) *Brown(hot), yellow(cold)*	Tak larut / *Insoluble*	PbO

Langkah 2: Tindakan Haba ke atas Garam
Step 2 : Effect of Heat on Salts

1. Mengeruhkan / *chalky*

2. perang / *Brown*
biru, merah / *blue, red*

Kation *Cation*	Karbonat (CO_3^{2-}) *Carbonate (CO_3^{2-})*	Nitrat (NO_3^-) *Nitrate (NO_3^-)*
Na^+	Tidak terurai / *Does not decompose*	$2NaNO_3 \rightarrow 2NaNO_2 + O_2$
K^+	Tidak terurai / *Does not decompose*	$2KNO_3 \rightarrow 2KNO_2 + O_2$
Mg^{2+}	$MgCO_3 \rightarrow MgO + CO_2$	$2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$
Ca^{2+}	$CaCO_3 \rightarrow CaO + CO_2$	$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$
Al^{3+}	$2Al_2(CO_3)_3 \rightarrow 2Al_2O_3 + 6CO_2$	$4Al(NO_3)_3 \rightarrow 2Al_2O_3 + 12NO_2 + 3O_2$
Zn^{2+}	$ZnCO_3 \rightarrow ZnO + CO_2$	$2Zn(NO_3)_2 \rightarrow 2ZnO + 4NO_2 + O_2$
Cu^{2+}	$CuCO_3 \rightarrow CuO + CO_2$	$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$
Pb^{2+}	$PbCO_3 \rightarrow PbO + CO_2$	$2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$
NH_4^+	$(NH_4)_2CO_3 \rightarrow 2NH_3 + CO_2 + H_2O$	$NH_4NO_3 \rightarrow N_2O + 2H_2O$

3. Stabil */ stable*

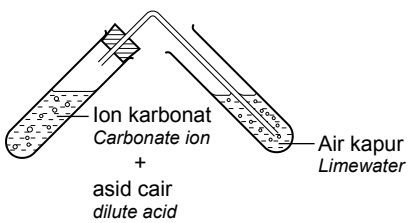
4. ammonium klorida */ ammonium chloride*
$NH_4Cl \rightleftharpoons NH_3 + HCl$
- sengit */ bungent*
- merah, biru */ red, blue*

Langkah 3: Ujian Anion dan Kation
Step 3 : Tests for Anions and Cations

A Ujian bagi anion
Anion tests

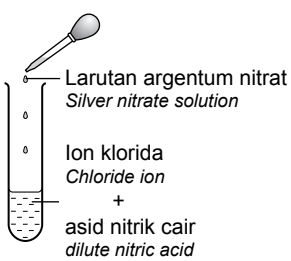
Anion
Anions

(a) Ion karbonat
Carbonate ion
CO_3^{2-}



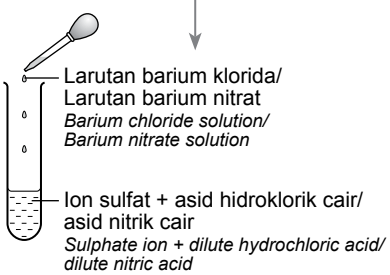
- Pembuakan berlaku.
  Effervescence occurs.
- Gas mengeruhkan air kapur.
  The gas turns limewater chalky.
- Persamaan ion:
  Ionic equation
  $CO_3^{2-} + 2H^+ \rightarrow H_2O + CO_2$

(b) Ion klorida
Chloride ion
Cl^-



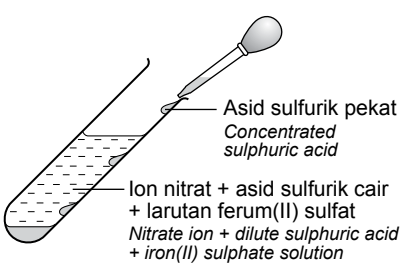
- Mendakan putih terbentuk.
  White precipitate is formed.
- Persamaan ion:
  Ionic equation
  $Ag^+ + Cl^- \rightarrow AgCl$

(c) Ion sulfat
Sulphate ion
SO_4^{2-}



- Mendakan putih terbentuk.
  White precipitate is formed.
- Persamaan ion:
  Ionic equation
  $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

(d) Ion nitrat
Nitrate ion
NO_3^-



- Cincin perang terbentuk.
  Brown ring is formed.

Eksperimen 6.9

Hipotesis / *Hypothesis*:

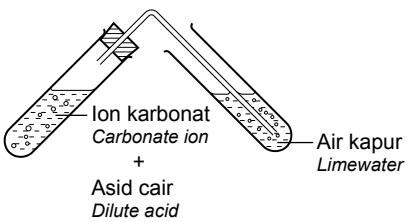
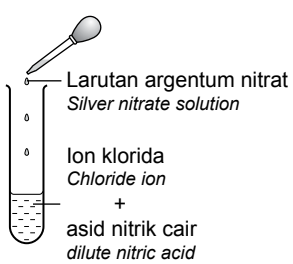
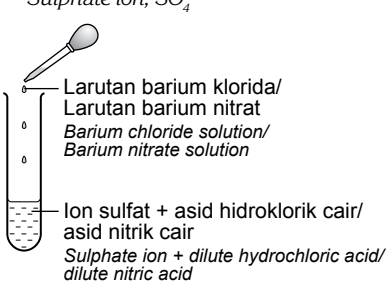
ujian kimia / *chemical tests*

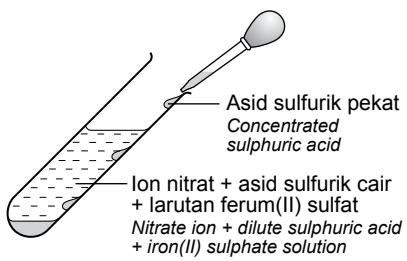
Pemboleh ubah / *Variables*:

(a) Jenis anion yang hadir di dalam larutan akueus / *Types of anions present in the aqueous solutions*

(c) Isi padu larutan garam akueus
Volume of aqueous salt solutions

Radas / *Apparatus*:

Ujian anion *Anion test*	**Prosedur** *Procedure*	**Pemerhatian** *Observation*	**Inferens** *Inference*
(a) Ion karbonat, CO_3^{2-} *Carbonate ion, CO_3^{2-}*  Persamaan ion / *Ionic equation:* $CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$	1. 2 cm^3 larutan karbonat dimasukkan ke dalam tabung uji. *2 cm^3 carbonate solution is put into a test tube.* 2. 2 cm^3 HCl ditambahkan. Gas dilalukan ke dalam air kapur. *2 cm^3 HCl is added. Gas is passed into limewater.*	– Pembuakan gas *Bubbles of gas* – Air kapur menjadi keruh. *Limewater becomes cloudy.*	Gas yang terhasil ialah karbon dioksida. *Gas produced is carbon dioxide.*
(b) Ion klorida, Cl^- *Chloride ion, Cl^-*  Persamaan ion / *Ionic equation:* $Ag^+ + Cl^- \rightarrow AgCl$	1. 2 cm^3 larutan klorida dimasukkan ke dalam tabung uji. *2 cm^3 chloride solution is put into a test tube.* 2. 2 cm^3 HNO_3 ditambahkan. *2 cm^3 of HNO_3 is added.* 3. 2 cm^3 larutan argentum nitrat ditambahkan. *2 cm^3 silver nitrate solution is added.*	Mendakan putih *White precipitate*	Argentum klorida *Silver chloride* Ion klorida hadir. *Chloride ion presents.*
(c) Ion sulfat, SO_4^{2-} *Sulphate ion, SO_4^{2-}*  Persamaan ion / *Ionic equation:* $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$	1. 2 cm^3 larutan sulfat dimasukkan ke dalam tabung uji. *2 cm^3 sulphate solution is put into a test tube.* 2. 2 cm^3 HCl ditambahkan. *2 cm^3 HCl is added.* 3. 2 cm^3 larutan barium klorida ditambahkan. *2 cm^3 barium chloride solution is added.*	Mendakan putih *White precipitate*	Barium sulfat *Barium sulphate* Ion sulfat wujud. *Sulphate ion presents.*

(d) Ion nitrat, NO_3^- *Nitrate ion, NO_3^-*  	1. 2 cm^3 larutan nitrat dimasukkan ke dalam tabung uji. *2 cm^3 nitrate solution is put into a test tube.* 2. 2 cm^3 H_2SO_4 ditambahkan. *2 cm^3 H_2SO_4 is added.* 3. 2 cm^3 larutan ferum(II) sulfat ditambahkan. Campuran digoncangkan. *2 cm^3 iron(II) sulphate solution is added. The mixture is shaken.* 4. H_2SO_4 pekat dimasukkan setitis demi setitis. *Concentrated H_2SO_4 is added drop by drop.*	Cincin perang terbentuk. *Brown ring is formed.*	Ion nitrathadir. *Nitrate ion presents.*

Perbincangan / *Discussion*:

1. negatif / *negative*

2. (a) asid / *asid*

Keputusan / *Result*:

pemerhatian / *observations*

❸ Ujian kation
Cation tests

natrium hidroksida, ammonia / *sodium hydroxide, ammonia*

(a) Larutan natrium hidroksida, NaOH / Sodium hydroxide solution, NaOH

(i) Pb^{2+} (v) Fe^{2+}
(ii) Mg^{2+} (vi) Zn^{2+}
(iii) Al^{3+} (vii) Pb^{2+}
(iv) Cu^{2+} (viii) Ca^{2+}

(b) Larutan ammonia, NH_4 / Ammonia solution, NH_4

(i) Zn^{2+} (v) Fe^{2+}
(ii) Al^{3+} (vi) Mg^{2+}
(iii) Ca^{2+} (vii) Pb^{2+}
(iv) Fe^{3+}

Eksperimen 6.10

Hipotesis / *Hypothesis*:

ujian kimia / *chemical tests*

Pemboleh ubah / *Variables*:

(a) Jenis kation yang hadir di dalam larutan akueus
Types of cations present in the aqueous solutions

(c) Isi padu larutan garam akueus
Volume of aqueous salt solutions

Keputusan / *Result*:

Larutan kation *Cation solution*	**Kation** *Cation*	**Pemerhatian** *Observation*			
		Sedikit larutan natrium hidroksida *Small amount of sodium hydroxide solution*	**Larutan natrium hidroksida berlebihan** *Excess of sodium hydroxide solution*	**Sedikit larutan ammonia** *Small amount of ammonia solution*	**Larutan ammonia berlebihan** *Excess of ammonia solution*
Kalsium nitrat *Calcium nitrate*	Ca^{2+}	Mendakan putih *White precipitate*	Tidak larut *Insoluble*	Tiada mendakan *No precipitate*	Tiada mendakan *No precipitate*
Magnesium nitrat *Magnesium nitrate*	Mg^{2+}	Mendakan putih *White precipitate*	Tidak larut *Insoluble*	Mendakan putih *White precipitate*	Tidak larut *Insoluble*
Zink nitrat *Zinc nitrate*	Zn^{2+}	Mendakan putih *White precipitate*	Larutan tidak berwarna *Colourless solution*	Mendakan putih *White precipitate*	Larutan tidak berwarna *Colourless solution*

Aluminium nitrat *Aluminium nitrate*	Al^{3+}	Mendakan putih *White precipitate*	Larutan tidak berwarna *Colourless solution*	Mendakan putih *White precipitate*	Tidak larut *Insoluble*
Plumbum(II) nitrat *Lead(II) nitrate*	Pb^{2+}	Mendakan putih *White precipitate*	Larutan tidak berwarna *Colourless solution*	Mendakan putih *White precipitate*	Tidak larut *Insoluble*
Ferum(II) sulfat *Iron(II) sulphate*	Fe^{2+}	Mendakan hijau *Green precipitate*	Tidak larut *Insoluble*	Mendakan hijau *Green precipitate*	Tidak larut *Insoluble*
Ferum(III) klorida *Iron(III) chloride*	Fe^{3+}	Mendakan perang *Brown precipitate*	Tidak larut *Insoluble*	Mendakan perang *Brown precipitate*	Tidak larut *Insoluble*
Kuprum(II) sulfat *Copper(II) sulphate*	Cu^{2+}	Mendakan biru *Blue precipitate*	Tidak larut *Insoluble*	Mendakan biru *Blue precipitate*	Larutan biru tua *Dark blue solution*
Ammonia klorida *Ammonium chloride*	NH_4^+	Tiada mendakan *No precipitate*		Tiada mendakan *No precipitate*	

Perbincangan / *Discussion*:

1. positif / *positive*

2. ammonia / *ammonia*

3. pemerhatian / *observations*

Keputusan / *Results*:

pemerhatian / *observations*

Eksperimen 6.11

Pemboleh ubah / *Variables*:

(a) Kation hadir / *Cations present*

(c) Isi padu larutan garam akueus / *Volume of aqueous salt solutions*

Radas / *Apparatus*:

Prosedur ***Procedure***	**Pemerhatian** ***Observation***	**Inferens** ***Inference***
(a) 1. 1 cm^3 larutan kalium iodida ditambahkan diikuti dengan 3 cm^3 air suling *1 cm^3 potassium iodide solution is added followed by 3 cm^3 distilled water.* 2. Campuran dipanaskan sehingga mendakan larut membentuk larutan tak berwarna. Kemudian, larutan tersebut disejukkan. *The mixture is heated until the precipitate dissolves forming colourless solution. Then, it is cooled.*	Mendakan kuning *Yellow precipitate*	Ion Pb^{2+} hadir *Pb^{2+} ion presents*
(b) 2 cm^3 larutan kalium heksasianoferat(III) ditambahkan *2 cm^3 potassium hexacyanoferrate(III) solution is added*	Mendakan biru tua *Dark blue precipitate*	Ion Fe^{2+} hadir *Fe^{2+} ion presents*
(c) 2 cm^3 larutan kalium heksasianoferat(II) ditambahkan *2 cm^3 potassium hexacyanoferrate(II) solution is added*	Mendakan biru tua *Dark blue precipitate*	Ion Fe^{3+} hadir *Fe^{3+} ion presents*
(d) 2 cm^3 larutan kalium tiosianat ditambahkan *2 cm^3 potassium thiocyanate solution is added*	Larutan merah darah *Blood red solution*	Ion Fe^{3+} hadir *Fe^{2+} ion presents*
(e) 2 cm^3 reagen Nessler ditambahkan *2 cm^3 Nessler reagent is added*	Mendakan perang *Brown precipitate*	Ion NH_4^+ hadir *NH_4^+ ion presents*

Prosedur / *Procedure*:

1. plumbum(II) / *Lead(II)*
2. ammonia / *ammonia*
3. ferum(III) / *Iron(III)*
4. Ion ferum(II) / *Iron(II)*

Keputusan / *Results*:

ujian / *cation*

PRAKTIS SPM 6

Soalan Objektif

1. D	**2.** A	**3.** D	**4.** A	**5.** C
6. B	**7.** D	**8.** B	**9.** A	**10.** C

Soalan Struktur

Bahagian A

1. (a) Bahan kimia yang mengion di dalam air menghasilkan ion hidrogen.
Chemical substance that ionises in water to produce hydrogen ions.

(b) Asid / *Acid P* : Asid etanoik / *Ethanoic acid*
Asid / *Acid Q* : Asid sulfurik / *Sulphuric acid*

(c) Asid *P* adalah asid lemah / mengion separa dalam air. // *Acid P is a weak acid / ionises partially in water*
Asid *Q* adalah asid kuat / mengion lengkap dalam air // *Acid Q is a strong acid / ionises completely in water*

(d) (i) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

(ii) Zn : H_2
0.5 : 0.5
Maka isi padu $H_2 = 0.5 \times 24$
So volume of H_2
$= 12.0\ dm^3$

(iii) Masukkan kayu uji bernyala ke dalam gas di dalam tabung uji. Bunyi 'pop' terhasil.
Put in a lighted wooden splinter into the gas in a test-tube. 'Pop' sound produced.

2. (a) Tidak larut / *Insoluble*

(b) Asid sulfurik // Asid nitrik // Asid sulfurus // Asid nitrus // Asid karbonik
Sulphuric acid // Nitric acid // Sulphurous acid // Nitrous acid // Carbonic acid

(c) (i) $CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + CO_2 + H_2O$

(ii) $CaCO_3$: CO_2
1.0 : 1.0
Maka, isi padu CO_2 / *So, volume of* CO_2
$= 1.0 \times 24$
$= 24.0\ dm^3$

(d) Natrium karbonat dan kalium karbonat
Sodium carbonate and Potassium carbonate

Bahagian B

3. (a) Kaedah I : Magnesium dan asid sulfurik
Method I : Magnesium and sulphuric acid
Kaedah II: Magnesium oksida dan asid sulfurik
Method II : Magnesium oxide and sulphuric acid

(b) (i) Garam X : Kuprum(II) karbonat
Salt X : Copper(II) carbonate
Pepejal Y : Kuprum(II) oksida
Solid Y : Copper(II) oxide
Gas Z : Karbon dioksida
Gas Z : Carbon dioxide
Ujian kimia untuk Gas Z:
Chemical test for Gas Z:
Alirkan gas ke dalam air kapur
Flow the gas into lime water
1. Air kapur menjadi keruh
Lime water turns cloudy

(ii) Kuprum(II) nitrat // *Copper(II) nitrate*
Ujian kation (Cu^{2+}):
Test for cation (Cu^{2+}):
1. Tambahkan larutan natrium hidroksida.
Add sodium hydroxide solution
2. Mendakan biru terbentuk.
Blue precipitate formed.

Ujian anion (NO_3^-)
Test for anion (NO_3^-)
1. Tambahkan 2 cm^3 asid sulfurik cair diikuti dengan 2 cm^3 larutan ferum(II) sulfat.
Add 2 cm^3 *sulphuric acid followed by of 2* cm^3 *iron(II) sulphate solution.*
2. Tambahkan perlahan-lahan asid sulfurik pekat
Add slowly concentrated sulphuric acid
3. Cincin perang terbentuk.
Brown ring is formed.

(iii) $CuO + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O$

Mole of $HNO_3 = \frac{1.0 \times 50}{1000}$ // 0.05

Daripada persamaan // *From the equation,*
2 mol HNO_3 : 1 mol $Cu(NO_3)_2$
0.05 mol HNO_3 : 0.025 mol $Cu(NO_3)_2$
Jisim / Mass $Cu(NO_3)_2 = 0.025 \times 188$ // 4.7 g

Bahagian C

4. (a) Cuka / *Vinegar*
Kerana berasid. Boleh meneutralkan sengat yang alkali dan dapat mengurangkan kesakitan
Becaise an acid. Can neutralise the alkali sting and can reduce the pain

(b) (i) MgO / ZnO / CuO
$MgSO_4$ / $ZnSO_4$ / $CuSO_4$

(ii) $MgO + H_2SO_4 \longrightarrow Mg\ SO_4 + H_2O$

(iii) Tambahkan 2 cm^3 larutan barium klorida
Add 2 cm^3 *of barium chloride solution.*
Mendakan putih terhasil
White precipitate produced.

(c) Bahan : Air suling / *Distilled water*
Radas: Bikar 50 cm^3, rod kaca, corong turas, kertas turas, mangkuk penyejat, penunu Bunsen,
Apparatus : 50 cm^3 beaker, glass rod, filter funnel, filter paper, evaporating dish, Bunsen burner

1. Masukkan campuran garam ke dalam bikar. Tuangkan air suling dan kacau.
Put the salt mixture in a beaker. Add in distilled water and stir.
2. Turaskan. Keringkan pepejal X karbonat dengan kertas turas.
Filter. Dry the solid X carbonate with a filter paper.
3. Masukkan hasil turasan ke dalam mangkuk penyejat. Panaskan hingga tepu..
Put the filtrate in an evaporating dish. Heat until saturated.
4. Sejukkan larutan. // *Cool the solution*
5. Turaskan garam X nitrat. Keringkan dengan kertas turas.
Filter salt X nitrate. Dry with a filter paper

Pemerhatian: Garam X karbonat tidak larut / Garam X nitrat larut.
Observation: X carbonate salt is insoluble / X nitrate salt is soluble

BAB 7

Kadar Tindak Balas
Rate of Reaction

7.1 Penentuan Kadar Tindak Balas
Determining Rate of Reaction

1. cepat, tinggi, lambat, rendah / *Fast, high, Slow, low*

Tindak balas cepat *Fast reaction*	Tindak balas lambat *Slow reaction*
Pembakaran *Combustion*	Pengaratan *Rusting*
Letupan *Explosion*	Fotosintesis *Photosynthesis*
Penyesaran *Displacement*	Penapaian *Fermentation*
Penguraian ganda dua *Double decomposition*	Respirasi *Respiration*

2. Perubahan, masa / *change, time*

3. Terus / *directly*

4. (a) Pertambahan / *Increase*
(b) Pengurangan / *Decrease*
(c) Pembentukan / *Formation*

5. (a) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
Bertambah, malar / *increases, constant*

(b) $CaCO_3 + HNO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$
– Jisim kelalang kon dan kandungannya semakin berkurang dengan masa kerana tindak balas berlaku dan membebaskan gas ke persekitaran.
The mass of conical flask becomes decreases with time because the raction occurs and releases the gas to environment.

(c) $Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO$

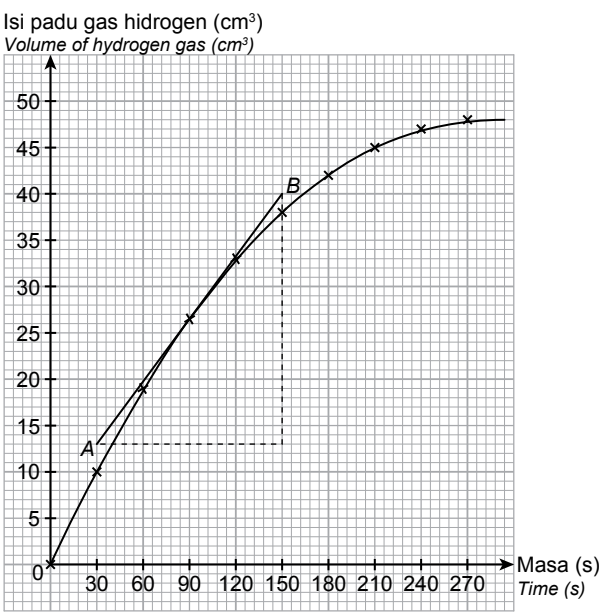
Contoh 2

(a) (i) $\frac{48}{240}$
$= 0.200$

(ii) $\frac{33}{120}$
$= 0.275$

(iii) $\frac{33 - 19}{120 - 60}$
$= 0.233$

(b) (i)



(ii) $\frac{40.0 - 13.0}{150 - 30} = 0.225\ cm^3\ s^{-1}$

7.2 Faktor yang Mempengaruhi Kadar Tindak Balas
Factors that Affect the Rate of Reaction

1. (a) Saiz, jumlah, pepejal / *Size, total, solid*
(b) Suhu / *Temperature*
(c) Kepekatan / *Concentration*
(d) mangkin / *catalyst*
(e) Tekanan / *Pressure*

Eksperimen 7.1

Hipotesis / *Hypothesis*:

kecil, tinggi / *smaller, higher*

Pemboleh ubah / *Variables*:

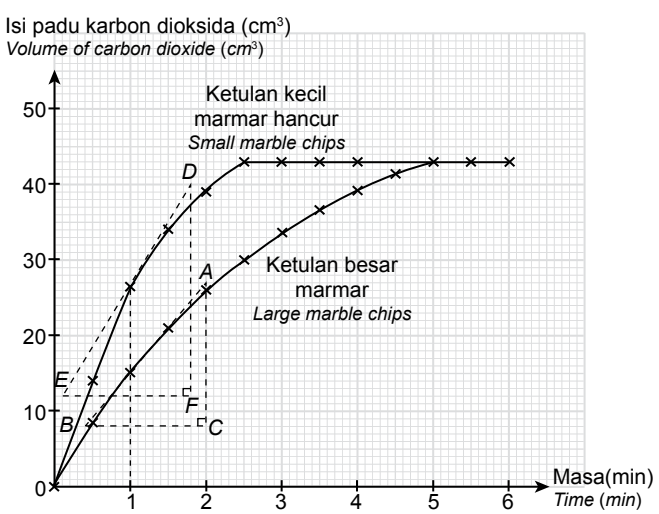
(a) Saiz ketulan marmar / *Size of marble chips*
(c) Jisim ketulan marmar / Suhu / *Mass of marble chips / Temperature*

Keputusan / *Results*:

Masa (min) *Time (min)*	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Bacaan buret (cm^3) *Burette reading (cm^3)*	49.40	40.90	34.40	28.40	23.40	19.40	15.90	12.90	10.40	8.10	6.40	6.40	6.40
Isi padu karbon dioksida terbebas (cm^3) *Volume of carbon dioxide released (cm^3)*	0.00	8.50	15.00	21.00	26.00	30.00	33.50	36.50	39.00	41.30	43.00	43.00	43.00

Masa (min) *Time (min)*	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Bacaan buret (cm^3) *Burette reading (cm^3)*	49.80	35.80	23.30	15.80	10.80	6.80	6.80	6.80	6.80
Isi padu karbon dioksida terbebas (cm^3) *Volume of carbon dioxide released (cm^3)*	0.00	14.00	26.50	34.00	39.00	43.00	43.00	43.00	43.00

Mentafsir data / *Interpreting data*:



Ketulan marmar besar / *Large marble chips:*

$= \frac{43.0}{5.0} = 8.6\ cm^3\ min^{-1}$

Ketulan marmar kecil / *Small marble chips:*

$= \frac{43.0}{2.5} = 17.2\ cm^3\ min^{-1}$

Perbincangan / *Discussion*:

1. karbon dioksida / *carbon dioxide*

$CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$

Kesimpulan / *Conclusion*:

1. kecil, tinggi / *smaller, higher*

Eksperimen 7.2

Hipotesis / *Hypothesis*:

tinggi, tinggi / *higher, higher*

Pemboleh ubah / *Variables*:

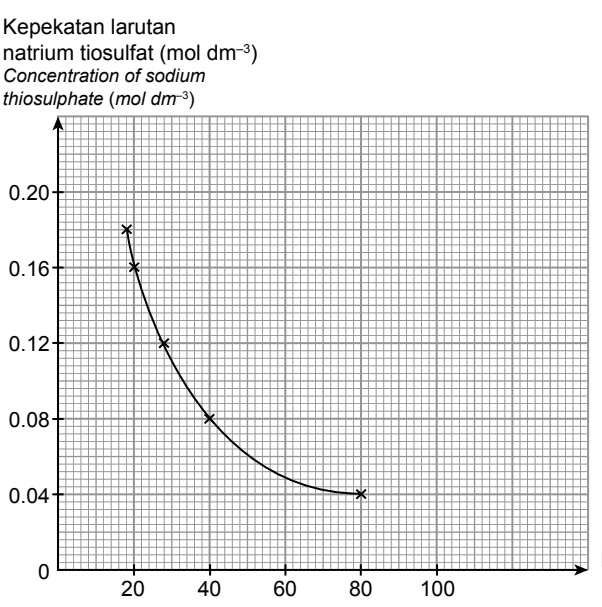
(a) Kepekatan / *Concentration*

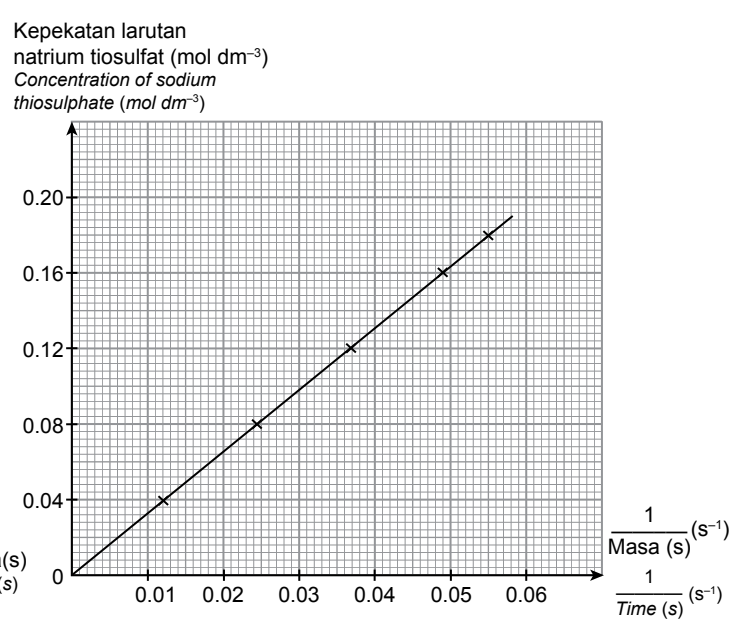
(c) Suhu / kepekatan dan isi padu asid sulfurik
Temperature / concentration and volume of sulphuric acid

Keputusan / *Results*:

Kepekatan larutan natrium tiosulfat dalam campuran tindak balas, M_2 (mol dm^{-3}) *Concentration of sodium thiosulphate solution in mixture, M_2 (mol dm^{-3})* ($M_2 = \frac{M_1V_1}{V_2}$)	$\frac{0.2(45)}{50}$ = 0.18	$\frac{0.2(40)}{50}$ = 0.16	$\frac{0.2(30)}{50}$ = 0.12	$\frac{0.2(20)}{50}$ = 0.08	$\frac{0.2(10)}{50}$ = 0.04
Masa diambil, *t*(s) *Time taken (s)*	18.18	20.05	26.98	40.82	83.24
Kadar tindak balas, $\frac{1}{t}$(s^{-1}) *Rate of reaction $\frac{1}{t}$(s^{-1})*	0.055	0.050	0.037	0.024	0.012

Mentafsir data / *Interpreting data*:





Perbincangan / *Discussion*:

1. kuning / *yellow*

2. hilang / *disappear*

3. (a) panjang / *longer*
(b) rendah / *lower*

5. banyak, bertambah, bertambah / *many, increases, increases*

6. (a) rendah / *lower*
(b) monoprotik, diprotik, separuh / *monoprotic, diprotic acid, half*

Kesimpulan / *Conclusion*:

meningkat / *increases*

Eksperimen 7.3

Hipotesis / *Hypothesis*:

tinggi, tinggi / *higher, higher*

Pemboleh ubah / *Variables*:

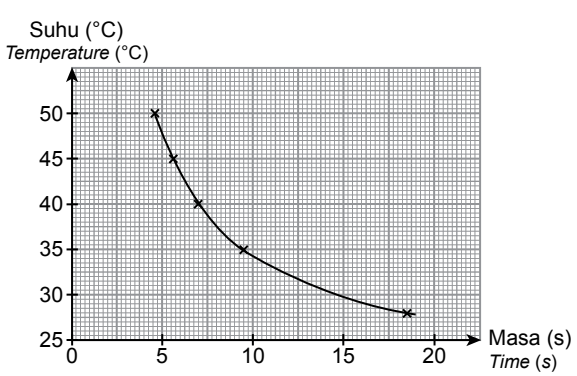
(a) Suhu / *Temperature*
(c) Kepekatan dan isi padu asid sulfurik
Concentration and volume of sulphuric acid

Keputusan / *Results*:

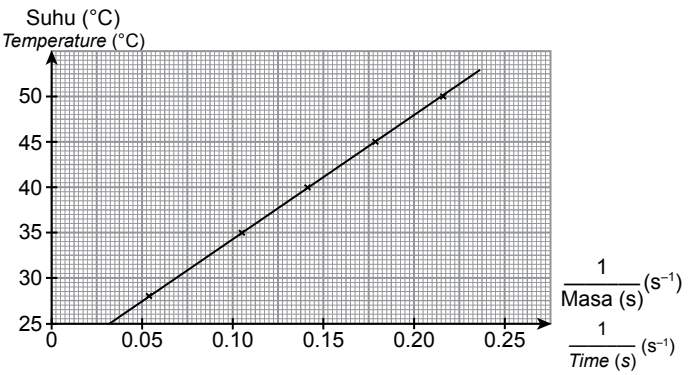
Eksperimen *Experiment*	**Suhu (°C)** *Temperature (°C)*	**Masa, *t*(s)** *Time, t(s)*	$\frac{\mathbf{1}}{\mathbf{masa}}$ **(s^{-1})** / $\frac{1}{time}$ *(s^{-1})*
I	28.0	18.52	0.054
II	35.0	9.48	0.105
III	40.0	7.07	0.141
IV	45.0	5.62	0.178
V	50.0	4.63	0.216

Mantafsir data / *Interpreting data*:

1.



3.



4. kinetik, bertambah / *kinetic, increases*

Perbincangan / *Discussion*:

$Na_2S_2O_3 + H_2SO_4 \longrightarrow 2Na_2SO_4 + H_2O + SO_2 + S$

1. (a) linear / *inversely*
(b) songsang / *inversely*
(c) suhu / *temperature*

2. (a) berkurang, bertambah / *decreases, increases*

Kesimpulan / *Conclusion*:

1. tinggi, tinggi / *higher, higher*

Eksperimen 7.4

Hipotesis / *Hypothesis*:

meningkatkan / *increases*

Pemboleh ubah / *Variables*:

(a) mangkin / *catalyst*
(c) Jisim mangan(IV) oksida / *Mass of manganese(IV) oxide*

Keputusan / *Results*:

Tabung uji *Test tube*	**Pemerhatian** *Observation*	**Inferens** *Inference*
I (MnO_2) *(without MnO_2)*	Membara malap *Glowing dimly*	Sedikit gas oksigen *Less oxygen gas*
II (dengan MnO_2) *(with MnO_2)*	Menyala terang *Burning brightly*	Banyak gas oksigen *Plenty of oxygen gas*

Perbincangan / *Discussion*:

1. oksigen, air / *oxygen, water*
$2H_2O_2 \longrightarrow O_2 + 2H_2O$

2. meningkatkan / *increases*

Kesimpulan / *Conclusion*:

1. meningkatkan / *increases*

7.3 Aplikasi Faktor yang Mempengaruhi Kadar Tindak Balas dalam Kehidupan
Application of Factors that Affect Rate of Reaction in Life

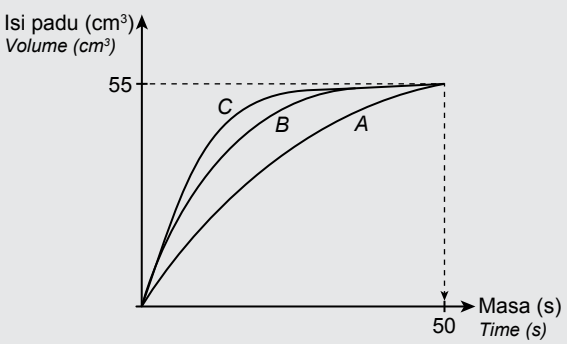
1. Mangkin – yis / *Catalyst – yeast*
Suhu – cepat / *Temperature – faster*
Saiz – kecil / *Size – smaller*
Kepekatan – kakisan / *Concentration – corrosion*

Tugasan 1

1. (a) Potongan nipis kentang mempunyai jumlah luas permukaan yang lebih besar berbanding dengan seluruh biji kentang. Minyak panas mempunyai suhu yang lebih tinggi berbanding dengan air mendidih.
Slices of potato cutlets have larger total surface area compared to whole potato. Hot oil has a higher temperature compared to boiling water.

(b) (i) $= \frac{50}{55}$
$= 0.91 \text{ cm}^3 \text{ s}^{-1}$

(ii)

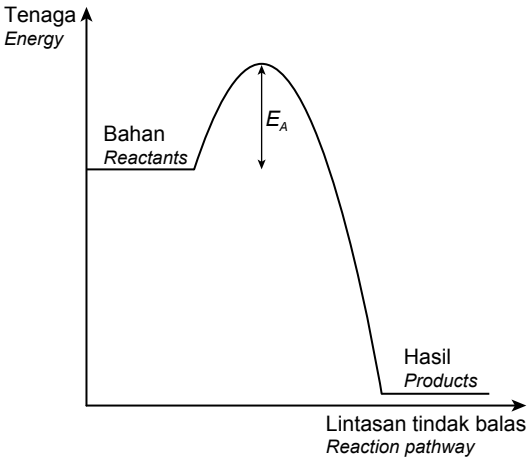


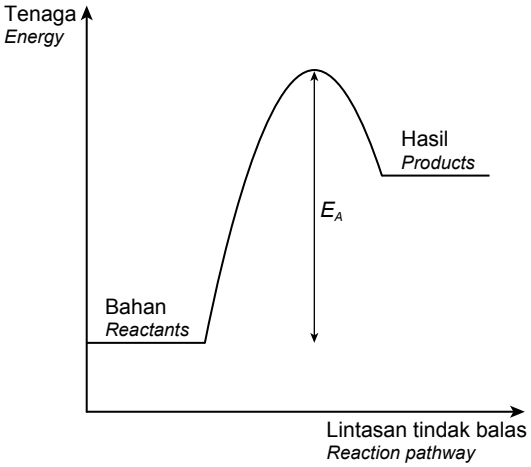
(c) Graf A: Kecerunan paling rendah. Kadar tindak balas paling rendah.
Graph A *Gradient the lowest. Rate of reaction the lowest.*
Graf B: Kecerunan lebih tinggi daripada Graf A kerana suhu lebih tinggi. Kadar tindak balas tinggi.
Graph B *Gradient is higher than Graph A because temperature is higher. Rate of reaction is high*
Graf C: Kecerunan paling tinggi kerana suhu tinggi dan jumlah luas permukaan $CaCO_3$ besar.
Graph C Kadar tindak balas paling tinggi.
Gradient is highest because temperature is high and total surface area is large.
Rate of reaction is the highest.

7.4 Teori Perlanggaran
Collision Theory

1. (a) halus, diskrit, bergerak / *moving, tiny, discrete*
(b) (i) perlanggaran / *collision*
(ii) perlanggaran berkesan / *effective collisions*
(c) kimia / *chemical*
(d) (i) sama, tinggi, pengaktifan / *same, more, activation*
(ii) betul / *correct*

2.





3. (a) minimum / *minimum*
(b) tenaga / *energy*
(c) perbezaan, puncak / *difference, peak*
(i) M = zink nitrat / *zinc nitrate*
N = hidrogen / *hydrogen*
(ii) $Zn + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2$
(iii) 40 kJ, 60 kJ
(iv) 0 – 40 = –40 kJ

Perlanggaran Berkesan dan Kadar Tindak Balas
Effective Collison and Rate of Reaction

1. tinggi, tinggi / *higher, higher*

2. (a)

Kepekatan bertambah / *Concentration increases*

↑ Bilangan zarah per unit isi padu
Number of particles per unit volume

↑ Frekuensi perlanggaran antara zarah-zarah
Frequency of collisions between particles

↑ Frekuensi perlanggaran berkesan antara zarah-zarah
Frequency of effective collisions between particles

↑ Kadar tindak balas / *Rate of reaction*

(b)

Jumlah luas permukaan bahan tindak balas bertambah
Total surface area of reactant increases

↑ Jumlah luas permukaan terdedah untuk perlanggaran
Total surface area exposed for collisions

↑ Frekuensi perlanggaran antara zarah-zarah
Frequency of collisions between particles

↑ Frekuensi perlanggaran berkesan antara zarah-zarah
Frequency of effective collisions between particles

↑ Kadar tindak balas / *Rate of reaction*

(c)

Suhu bertambah / *Temperature increases*

↑ Tenaga kinetik zarah-zarah bahan tindak balas
Kinetic enegry of reactant particles

↑ Bilangan zarah yang bertenaga untuk mengatasi tenaga pengaktifan / *Number of reactant particles that achieve the activation energy*

↑ Frekuensi perlanggaran berkesan antara zarah-zarah
Frequency of effective collisions between particles

↑ Kadar tindak balas / *Rate of reaction*

(d)

Kehadiran mangkin / *Presence of catalyst*

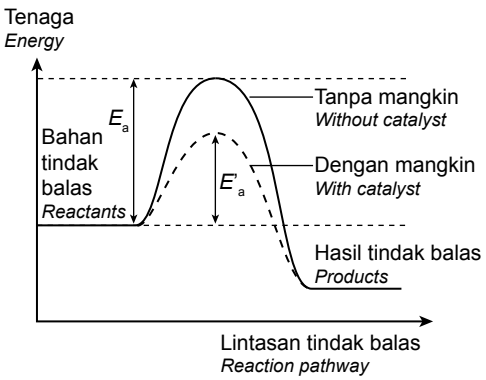
↓ Tenaga pengaktifan
Activation energy

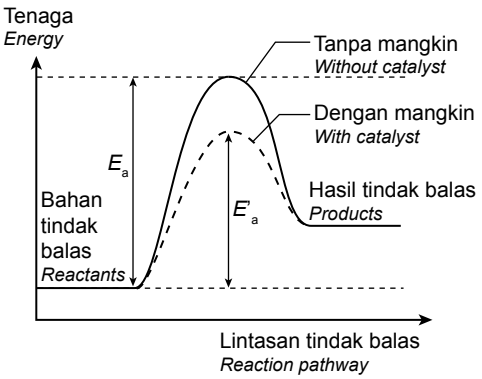
↑ Bilangan zarah bahan tindak balas yang mencapai tenaga pengaktifan
Number of reactant particles that achieve the activation energy

↑ Frekuensi perlanggaran berkesan antara zarah-zarah
Frequency of effective collisions between particles

↑ Kadar tindak balas / *Rate of reaction*

3.





PRAKTIS SPM 7

Soalan Objektif

1. D	**2.** B	**3.** A	**4.** B	**5.** A
6. C	**7.** B	**8.** C	**9.** C	**10.** D

Soalan Struktur

Bahagian A

1. (a) Bahan yang meningkatkan kadar tindak balas tetapi dirinya tidak berubah secara kimia.
Substance that increase the rate of reaction but itself remains chemically unchanged.

(b) Kuprum(II) sulfat / *Copper(II) sulphate*

(c) (i) Set I : $\frac{40}{2}$
$= 20\ cm^3\ min^{-1}$

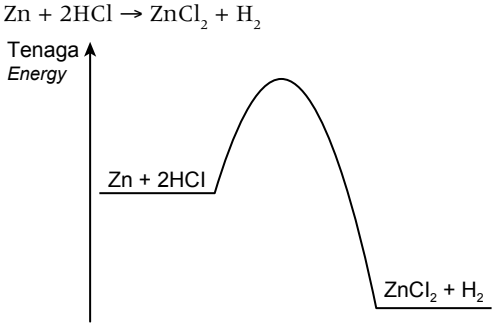
Set II: $\frac{60}{2}$
$= 30\ cm^3\ min^{-1}$

(ii) Kadar tindak balas Set II lebih tinggi
Rate of reaction of Set II is higher

(iii) Mangkin *Y* merendahkan tenaga pengaktifan tindak balas itu. Frekuensi perlanggaran berkesan meningkat.
Catalyst Y lowered the activation energy of the reaction. Frequency of effective collision increase.

(d) (i) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

(ii)

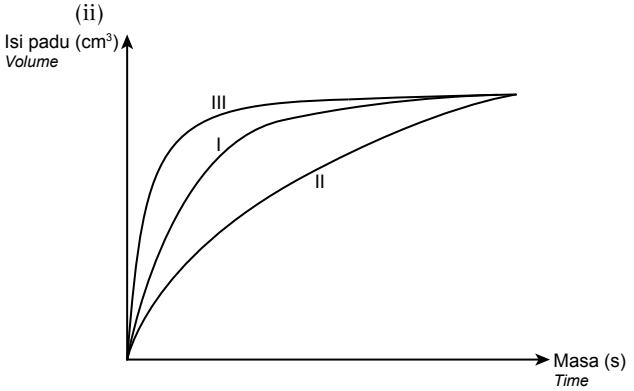


Bahagian B

2. (a) – Suhu di dalam peti sejuk lebih rendah daripada suhu bilik.
The temperature in a refrigerator is lower than room temperature
– Aktiviti bakteria rendah dalam peti sejuk.
Bacterial activity is lower in refrigerator
– Kurang toksin yang dihasilkan oleh bakteria.
Less toxin produced by bacteria.
– Kadar makanan menjadi rosak adalah rendah.
The rate of fruit spoilage is lower in refrigerator than room temperature.

(b) (i) $CaCO_3 + 2HCl \rightarrow ZnCl_2 + H_2O + CO_2$
$2HCl : CO_2$
2 mol 1 mol
mol HCl $= \frac{50 \times 10}{1000}$
// 0.05 mol CO_2 = 0.05 /2 // 0.025
Isi padu of CO_2 = 0.025 × 24
Volume = 0.6 dm^3 // 600 cm^3

(ii)



[label paksi dengan nama dan unit, Bentuk betul dan label betul]
[Axes label with name and unit. Correct shape and labelled]

(iii) III, I ,II
Experiment I dan III
Experiment I and III
Kadar tindak balas Eksperimen III lebih tinggi

Faktor bagi Eksperimen III ialah kepekatan
Kepekatan tinggi, kepekatan ion hidrogen tinggi
Frekuensi perlanggaran antara ion hidrogen dan $CaCO_3$ tinggi
Frekuensi perlanggaran berkesan antara ion hidrogen dan $CaCO_3$ tinggi
Kadar tindak balas purata bagi Eksperimen II
Average rate of reaction for Experiment II

$$= \frac{600}{45}$$
$$= 13.33 \text{ cm}^3 \text{ s}^{-1}$$

Bahagian C

3. (a) Asid hidroklorik (terima asid kuat lain yang betul)
Hydrochloric acid (accept any correct strong acid)
Asid kuat / mengion lengkap di dalam air
A strong acid / ionized completely in water
Kepekatan ion hidrogen tinggi
Produced high concentration of H^+
Frekuensi perlanggaran antara ion hidrogen dengan serbuk penaik meningkat
Frequency of collision between hydrogen ion and baking powder increases

(b) (i) Set I : 0.1 mol dm^{-3} // 0.5 mol dm^{-3} // 1.0 mol dm^{-3}
Set II: 0.2 mol dm^{-3} // 1.0 mol dm^{-3} // 2.0 mol dm^{-3}
[Kepekatan asid dalam Set II adalah 2 kali ganda Set I]
(Concentration of acid used in set II is double of set I]

(ii) Kadar tindak balas Set II lebih tinggi [dari Set I]
Rate of reaction in Set II is higher [than Set I]
Kepekatan ion hidrogen dalam Set II lebih tinggi / 2 kali ganda
Concentration of hydrochloric acid in Set II is higher/ double.
Frekuensi perlanggaran antara ion hidrogen dengan atom zink
Frequency of collision between hydrogen ions and zinc atoms is higher.
Frekuensi perlanggaran berkesan lebih tinggi
Frequency of effective collision is higher

(c) Bahan: [0.1 – 2.0] mol dm^{-3} larutan narium tiosulfat, 0.2 mol dm^{-3} asid hidroklorik , kertas putih
Materials : [0.1 – 2.0] mol dm^{-3} sodium thiosulphate solution, 0.2 mol dm^{-3} hydrochloric acid white paper
Radas: kelalang kon 100 cm^3, thermometer, penunu Bunsen, jam randik, selinder penyukat 50 cm^3,10 cm^3, tungku kaki tiga,
Apparatus: conical flask 100 cm^3, thermometer, Bunsen burner , stop watch , measuring cylinder 50 cm^3 dan 10 cm^3, tungku kaki tiga,

Prosedur / *Procedure*:
1. Sukat [25 – 100] cm^3 of larutan narium tiosulfat dan tuang ke dalam kelalang kon.
Measure [25 – 100] cm^3 of sodium thiosulphate solution and pour into conical flask.
2. Sukat suhu awal larutan dan rekodkan.
Measure the initial temperature of the solution and record it.
3. Letakkan kelalang kon di atas ketas putih bertanda 'X'
Place the conical flask on top of white paper with mark 'X'
4. Tambahkan [5 – 10] cm^3 asid hidroklorik ke dalam kelalang kon.
Add [5 – 10] cm^3 hydrochloric acid into conical flask.
5. Hidupkan jam randik dengan segera. Pusar kelalang kon.
Start the stopwatch immediately. Swirl the conical flask.
6. Matikan jam randik apabila pangkah'X' hilang. Rekodkan masa.
Stop the stopwatch when the mark 'X' disappeared. Record the time.
7. Ulang langkah 1 hingga 6 dengan suhu yang berlainan.
Repeat step 1 to 7 using different temperatures.

Pemerhatian: Mendakan kuning terhasil
Observation: Yellow precipitate produce

BAB 8 Bahan Buatan Dalam Industri
Manufactured Substances in Industry

8.1 Aloi dan Kepentingannya
Alloy and Its Importance

1. campuran, logam / *mixture, metal*
Loyang, keluli, keberkesanan / *brass, steel, effectiveness*

Eksperimen 8.1

A Ketahanan kepada kakisan
Resistant to corrosion

Hipotesis / *Hypothesis*:

tahan / *resistant*

Pemboleh ubah / *Variables*:

(a) Jenis plat / *Type of plate*
(c) Saiz plat dan isi padu air suling / *Size of plate and volume of distilled water*

Keputusan / *Results*:

Jenis plat *Type of plate*	**Keadaan permukaan plat** *Condition of plate's surface*	
	Sebelum direndam ke dalam air suling *Before immersing into distilled water*	**Selepas direndam di dalam air suling** *After immersing into distilled water*
Keluli nirkarat *Stainless steel*	Licin *Smooth*	Tiada perubahan *No changes*
Besi *Iron*	Licin *Smooth*	Terkakis *Corroded*

B Kekerasan bahan
Hardness of substances

Hipotesis / *Hypothesis*:

keras / *harder*

Pemboleh ubah / *Variables*:

(a) Gangsa dan logam tulennya (kuprum) / *Bronze and its pure metal (copper)*
(c) Saiz bola keluli / jisim pemberat / ketinggian pemberat / *Size of steel ball / mass of weight / height of weight*

Prosedur / *Procedure*:

Bongkah *Block*	**Diameter lekuk(cm)** *Diameter of dent*			
	I	**II**	**III**	**Purata** *Average*
Kuprum / *Copper*	2.8	2.8	2.9	2.8
Gangsa / *Bronze*	2.0	2.2	2.1	2.1

Perbincangan / *Discussion*:

1. rendah / *lower*

2. kecil, keras, gangsa / *smaller, stronger, bronze*

3. tahan, kuat / *resistant, stronger*

Kesimpulan / *Conclusion*:

1. tahan, keras / *resistant, harder*

Perbandingan antara susunan atom-atom dalam logam tulen dengan aloi
Comparison between the arrangement of atoms in pure metal and alloy

Logam tulen *Pure metal*	**Aloi** *Alloy*
(a) Satu, sama / *One, same*	(a) Asing / *foreign*
(b) Teratur / *orderly*	(b) Terganggu / *disrupted*
(c) mudah / *easily*	(c) sukar / *hardly*
(d) (i) Mulur / *Ductile* (ii) Boleh ditempa / *Malleable*	(d) (i) Keras / *Hard*

8.2 Komposisi Kaca dan Kegunaannya
Composition of Glass and Its Uses

1. silikon dioksida, SIO_2 / *silicon dioxide, SIO_2*

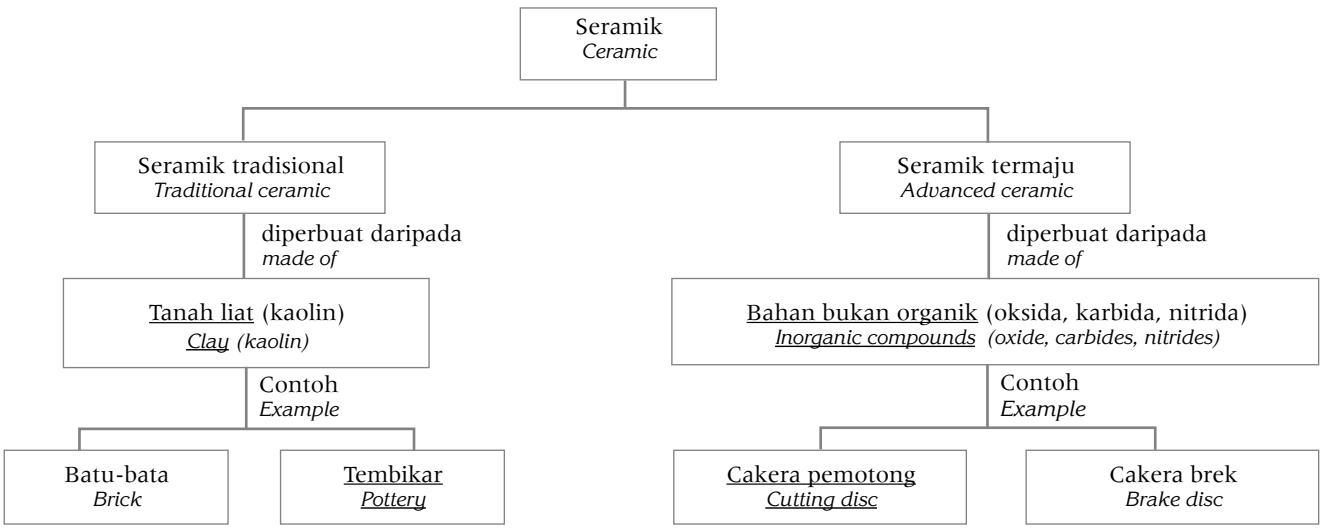
2.

Jenis kaca *Types of glass*	**Komposisi** *Composition*	**Sifat** *Properties*	**Kegunaan** *Use*
Kaca silika terlakur *Fused silica glass*	Silika, SiO_2 *Silica, SiO_2*	– Takat lebur tinggi *High melting point* – Tidak mengecut atau mengembang dengan banyak apabila suhu berubah *Does not contract or expand under temperature change*	Kanta teleskop *Telescope lens*
Kaca soda kapur *Soda lime glass*	– Silika, SiO_2 *Silica, SiO_2* – Natrium karbonat, Na_2CO_3 *Sodium carbonate, Na_2CO_3* – Kalsium karbonat, $CaCO_3$ *Calcium carbonate, $CaCO_3$*	– Takat lebur rendah *Low melting point* – Mudah dibentuk *Easily moulded* – Tidak tahan haba *Not resistant to heat* – Mudah retak apabila suhu berubah *Easily cracks under temperature change*	Bekas kaca *Glass containers* Botol dan jug air *Bottles and jugs*
Kaca borosilikat *Borosilicate glass*	– Silika, SiO_2 *Silica, SiO_2* – Natrium karbonat, Na_2CO_3 *Sodium carbonate, Na_2CO_3* – Kalsium karbonat, $CaCO_3$ *Calcium carbonate, $CaCO_3$* – Boron oksida, B_2O_3 *Boron oxide, B_2O_3* – Aluminium oksida, Al_2O_3 *Aluminium oxide, Al_2O_3*	Tahan haba *Resistant to heat* – Sukar retak apabila suhu berubah *Hardly cracks under temperature change*	Radas kaca makmal *Bikar, kelalang* Laboratory glassware *Beaker, flasks*
Kaca plumbum *Lead crystal glass*	– Silika, SiO_2 *Silica, SiO_2* – Natrium karbonat, Na_2CO_3 *Sodium carbonate, Na_2CO_3* – Plumbum(II) oksida, PbO *Lead(II) oxide, PbO*	Indeks pembiasan tinggi *High refractive index*	Prisma *Prisms*

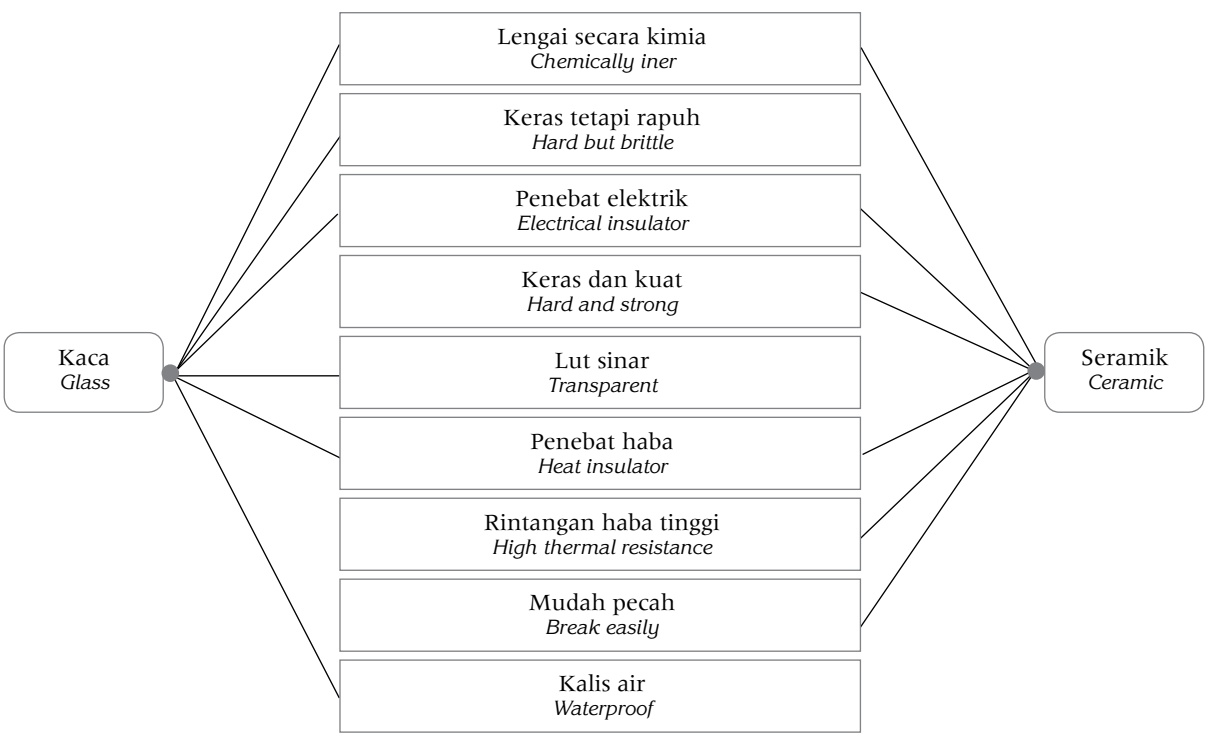
8.3 Komposisi Seramik dan Kegunaannya
Composition of Ceramics and Its Uses

1. organik, bukan logam / *inorganic, non-metallic*

2.



3.



8.4 Bahan Komposit dan Kepentingannya
Composite Materials and their Importance

1. bukan homogen, matriks, pengukuhan
Non-homogenuous, matrix, strengthening

2. (a) Konkrit / *Concret*
(b) Gentian kaca / *Glass fibre*
(c) cahaya / *light*
(d) Kaca fotokromik / *Photochromic glass*
(e) Elektromagnet / *electromagnet*

PRAKTIS SPM 8

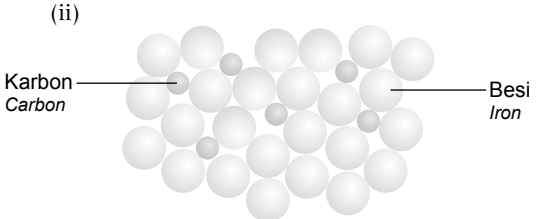
Soalan Objektif

1. C	**2.** B	**3.** A	**4.** D	**5.** B
6. A	**7.** C	**8.** D	**9.** A	**10.** B
11. C				

Soalan Struktur

***Bahagian* A**

1. (a) Campuran dua atau lebih unsur dengan komposisi tetap di mana komponen utama ialah logam.
Mixture of two or more element with fixed composition where the major component is metal.
(b) (i) Duralumin / *Duralumin*
(ii) Ringan dan Kuat // *Light and Strong*
(c) (i) Besi / Karbon // *Iron / Carbon*
(ii)



2.

Jenis kaca *Type of glass*	**Kegunaan** *Uses*	**Sifat** *Properties*
Kaca plumbum *Lead crystal glass*		Indeks biasan tinggi *High refractive index*
Kaca soda kapur *Soda lime glass*		Tahan terhadap bahan kimia *Resistant to chemicals*
Kaca borosilikat *Borosilicate glass*		Tahan haba tinggi *Resistant to high heat*
Kaca silika terlakur *Fused glass*		Tahan haba dan bahan kimia *Resistant to heat and chemicals*

(a) Silikon dioksida / *Silicon dioxide*
(c) Kaca silika terlakur / *Fused glass*

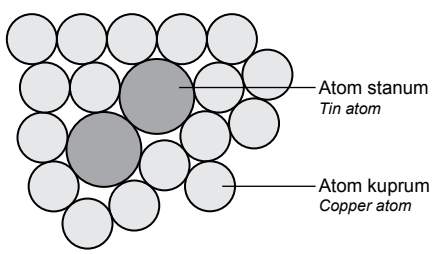
Bahagian B

3. (a) W: Tanah liat / *clay*
X: Plumbum(II) oksida / *Lead(II) oxide*
Y: Keluli / *Steel*
Z: Zink / *Zinc*
Sifat khusus: – Sangat lutsinar
Very transparent
– Indeks biasan tinggi
High refractive indexs

(b) (i) Aloi ialah campuran dua atau lebih unsur mengikut peratusan tertentu, di mana atom utamanya ialah logam.
Alloy is a mixture of two or more elements with a certain fixed percentage in which the major component is a metal
– untuk meningkatkan kekerasan dan kekuatan
to increase hardness and strength of pure metal.

(ii) Stanum / *Tin*

(c) Kuprum = 4.1 cm
Copper
Gangsa = 1.65 cm
Bronze



Kuprum tulen *Pure copper*	**Gangsa** *Bronze*
Diameter lekuk lebih besar / dalam *Diameter of dent is bigger / deeper*	Diameter lekuk lebih kecil / cetek *Diameter of dent is smaller / shallow*
Saiz atom sama / jenis atom sama *Same atomic size / same type of atom*	Saiz atom berbeza / jenis atom berbeza *Different atomic size / different types of atom*
Terdiri dari atom kuprum sahaja *Consists of copper atoms only*	Terdiri daripada atom kuprum dan stanum *Consists of copper and tin atoms*
Susunan atom teratur *Orderly atom arrangement*	Susunan atom tidak teratur / atom Sn menganggu susunan atom C *Arrangement of atoms not orderly / Tin atoms disturb arrangement of copper atoms*
Apabila dikenakan daya, lapisan atom senang menggelongsor *Sliding easily when force is applied*	Kurang menggelongsor apabila dikenakan daya *Reduce sliding when force is applied*
Kurang keras *Less hard*	Lebih keras *Harder*

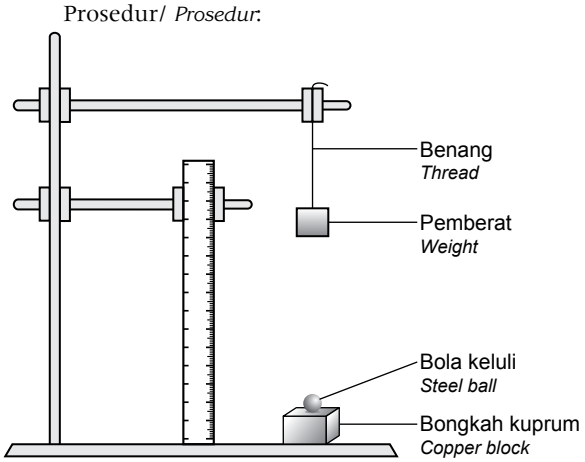
Bahagian C

4. (a) Kaca gentian dan Plastik
Fibre glass and Plastic
Ciri-ciri istimewa
Specific properties
Keras // Ringan // Mempunyai kekuatan regangan yang tinggi //
Mempunyai ketumpatan yang rendah // Mudah diwarnakan //
Mudah diacu dan dibentuk
Hard // Light // High tensile strength // Low density // Easy to colour // easy to mould and shape
[Mana – mana dua ciri] / [*Any two properties*]

(b) (i) Bahan yang diperbuat daripada gabungan dua atau lebih bahan berbeza seperti logam, aloi, seramik, kaca dan polimer.
Materials that are formed by combining two or more different substances such as metal, alloys, ceramics, glass and polymers.
Bahan ini mempunyai ciri-ciri yang lebih baik daripada komponen asalnya
Materials has properties that are superior than the original components

(ii) Konkrit yang diperkukuhkan:
Reinforced concrete:
Pembinaan bangunan tinggi, pelantar minyak
Construction of high-rise buildings, oil platforms
Kaca fotokromik: Membuat kanta cermin mata, cermin depan kereta
Photochromic glass: Making optical lens, car windshields

(c) Bahan: Bongkah kuprum, bongkah gangsa, bola keluli, 1 kg pemberat, pembaris, kaki retort dengan pemegang, pita selofan dan benang
Materials: Copper block, bronze block, steel ball, 1 kg weight, ruler, retort stand with clamp, cellophane tape and thread
Rajah / *Diagram*
Prosedur/ *Prosedur*:



1. Apitkan pembaris pada kaki retort dan letakkan bongkah kuprum di atas tapak kaki retort. *Clamp a ruler to the retort stand and place a copper block on the base of the retort stand.*

2. Letakkan bola keluli di atas bongkah kuprum menggunakan pita selofan.
   Place a steel ball on the copper block using cellophane tape.
3. Gantungkan 1 kg pemberat pada ketinggian 50 cm dari bongkah kuprum.
   Hang a 1 kg weight at a height of 50 cm from the copper block.
4. Jatuhkan pemberat ke atas bola keluli dan ukur diameter lekuk yang terbentuk. Rekodkan.
   Release the weight on the steel ball and measure the diameter of the dent formed. Record the reading.
6. Ulang eksperimen tiga kali pada kawasan bongkah kuprum yang berbeza.
   Repeat experiment three times at different areas of the copper block.
7. Hitung purata diameter lekuk.
   Calculate the average diameter of the dent.
8. Ulang langkah 1 hingga 5 menggunakan bongkah gangsa.
   Repeat steps 1 to 5 using bronze block.

Pemerhatian: Diameter lekuk logam kuprum lebih besar daripada gangsa
Observation: Diameter of the dent for copper metal is bigger than bronze

Kesimpulan: Aloi lebih kuat daripada logam tulennya
Conclusion: Alloy is harder than its pure metal