Jawapan

Bab 1

Bab 1 Pengenalan kepada Kimia
Intoduction to Chemistry

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

Apakah kimia?
What is chemistry?

struktur, sifat, komposisi, interaksi
structure, properties, compositions, interactions

Bahan Kimia dalam Kehidupan Harian
Chemicals in Daily Life

Bahan kimia dalam kehidupan harian
Chemicals in daily life

(a) Makanan
Food
Pengawet, pewarna, perisa, pengantioksida
Preservative, colouring, flavouring, antioxidant

(b) Perubatan
Medicine
Antibiotik, antiseptik, vitamin, analgesik
Antibiotic, antiseptic, vitamin, analgesic

(c) Industri
Industry
Cat, polimer, kaca, seramik, detergen, aloi
Paint, polymer, glass, ceramic, detergent, alloy

(d) Pertanian
Agriculture
Baja, racun herba, racun serangga
Fertiliser, herbicide, pesticide

Perkembangan Bidang Kimia dan Sumbangan Teknologi Kimia
Development in Chemistry Field and Contributions of Chemical Technology

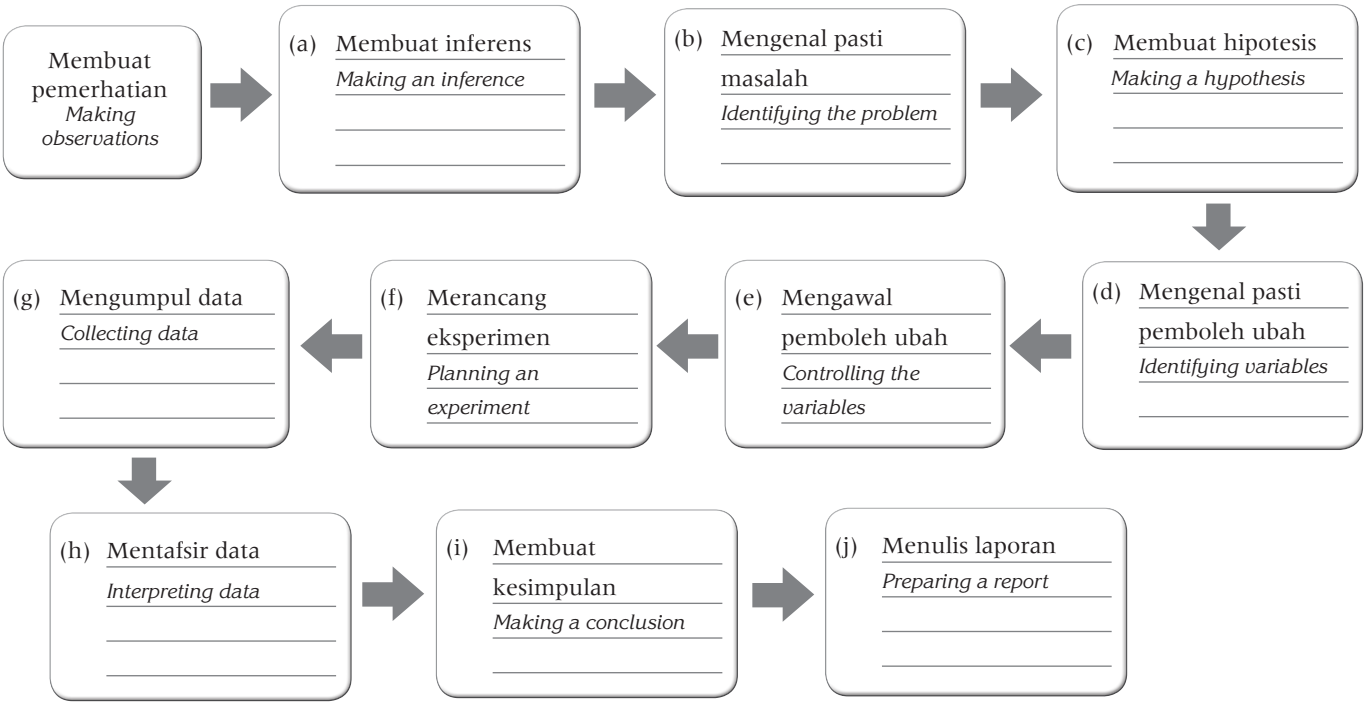
1. kimia / *Chemistry*
2. Nanoteknologi / *Nanotechnology*

Kerjaya Berkaitan dengan Bidang Kimia
Careers Related to Chemistry

(c) – Jurutera nanoteknologi / *Nanotechnology engineer*
– Ahli sains pemakanan / *Food scientist*
(d) – Doktor / *Doctor*
– Ahli farmasi / *Pharmacist*

1.2 Penyiasatan Saintifik dalam Kimia
Scientific Investigation in Chemistry

Langkah-langkah dalam Kaedah Saintifik
Steps in Scientific Method



Eksperimen 1.1

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 / ***Variables:***
Dimanipulasikan: Suhu air
***Manipulated**: Temperature of water*

Dimalarkan: Isi padu air // Jisim garam // Masa
***Fixed**: Volume of water // Mass of salt // Time*

Keputusan / ***Results:***

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

Mentafsir data / ***Interpreting data:***
(a) 10°C
(b) 80°C

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

1.3 Penggunaan, Pengurusan dan Pengendalian Radas serta Bahan Kimia
Usage, Management and Handling of Apparatus and Materials

Fungsi Alat Pelindung Diri dan Peralatan Keselamatan di dalam Makmal
Function of Personal Protective Equipment and Safety Equipment in the Laboratory

Alat pelindung diri *Personal protective equipment*	Fungsi *Function*
1. Sarung tangan *Gloves*	Melindungi tangan daripada bahan kimia, kecederaan atau jangkitan *Protect the hands from chemicals, injuries and infection*
2. Baju dan kasut makmal *Laboratory coat and shoes*	Melindungi kulit, pakaian dan kaki daripada tumpahan bahan kimia *Protect skin, clothing and feet from chemicals spills*
3. Pencuci mata *Eyewash*	Untuk membasuh dan membersihkan mata apabila kemalangan berlaku *To wash and clean the eyes when accidents occur*
4. Topeng muka *Face mask*	Melindungi organ pernafasan daripada serbuk atau wasap bahan kimia *Protect respiratory organ from chemical powder and fumes*

Pengurusan dan Pengendalian Radas dan Bahan Kimia
Management and Handling of Apparatus and Chemicals

1. minyak parafin / *paraffin oil*
2. berkunci / *locked*
3. organik / *Organic*

Langkah Pengurusan Kemalangan di dalam Makmal
Emergency Management Procedure in the Laboratory

1. guru / *teacher*
2. kawasan tumpahan / *accident side*
3. pasir / *sand*
4. Bersihkan / *Clean*
5. Lupuskan / *Dispose*

Praktis SPM 1

Soalan **Objektif**

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

Praktis Ekstra SPM 1

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

Jawapan

Bab 2

Bab 2 Jirim dan Struktur Atom
Matter and the Atomic Structure

2.1 Konsep Asas Jirim
Basic Concepts of Matter

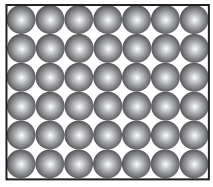
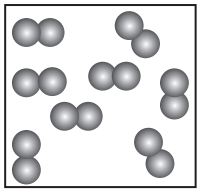
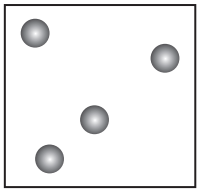
Jirim
Matter

1. jisim ruang / *mass* space

2. halus, diskrit / *fine, discrete*

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

5.

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.*

Perubahan Keadaan Jirim
Changes in the State of Matter

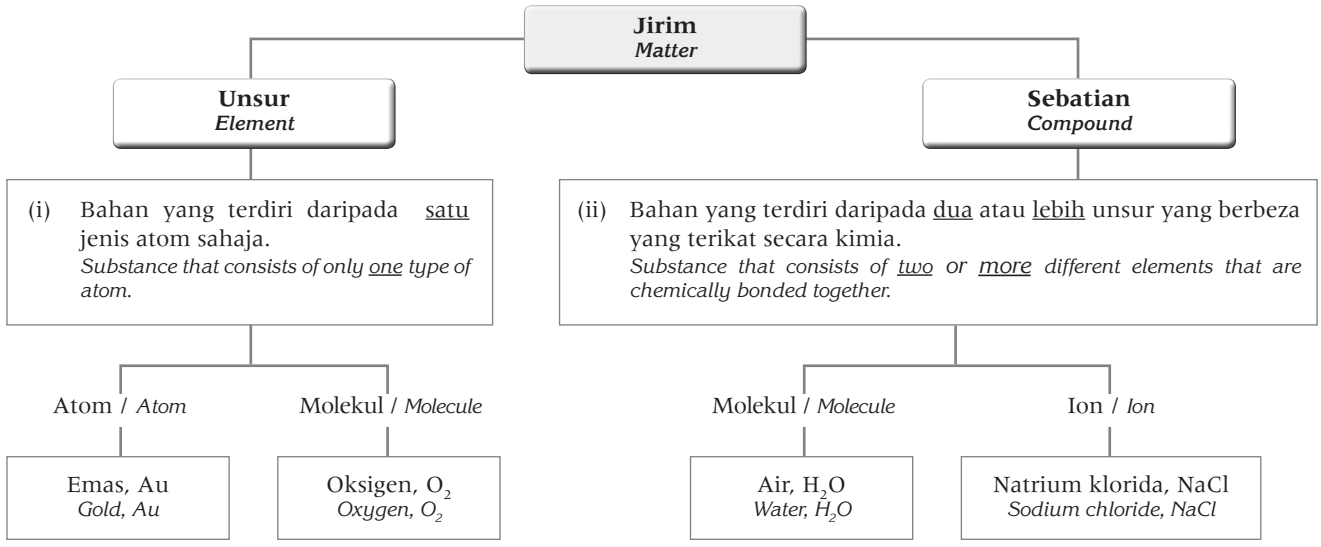
1. pemanasan; penyejukan / *heating; cooling*

2. diserap; dibebaskan / *absorbed; released*

3. tenaga kinetik / *kinetic energy*

4. (a) (i) Peleburan / *Melting*
(ii) Pendidihan / Penyejatan *Boiling/ Evaporation*
(iii) Kondensasi / *Condensation*
(iv) Pembekuan / *Freezing*
(b) pepejal, cecair / *solid, liquid*
(c) cecair, pepejal / *liquid, solid*
(d) tenaga kinetik / *kinetic energy*

6.



Eksperimen 2.1

Keputusan / *Results:*

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 kinetik 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.*

Perbincangan / *Discussion:*

1. (a) pepejal, gas, terbakar / *solid, gas, flammable*
   (b) pemanasan, sekata / *even heating*
2. (a) penyejukan, sekata / *even cooling*
   (b) Supaya haba hilang ke persekitaran dengan sekata
   To ensure heat is lost to the surroundings evenly

Kesimpulan / *Conclusion:*

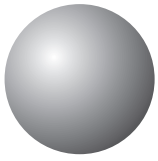
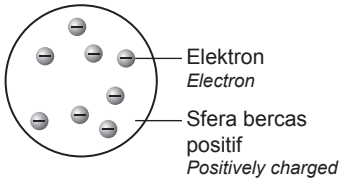
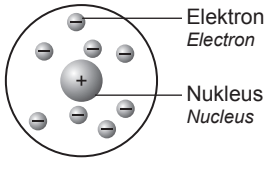
78 °C, 78 °C, sama / *same*

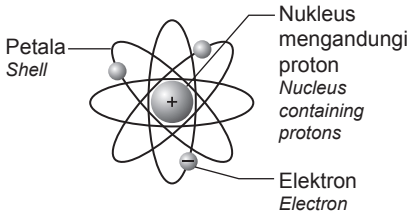
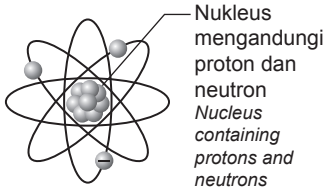
2.2 Perkembangan Model Atom
The Development of the Atomic Model

Zarah Subatom
Subatomic Particles

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

Sejarah Perkembangan Model Atom
The Historical Development of Atomic Models

Ahli Sains *Scientist*	**Model atom** *Atomic model*	**Penemuan** *Discovery*
John Dalton (1766-1844)		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*
J.J Thomson (1856-1940)		(i) Menjumpai elektron *Discovered electron* (ii) Atom ialah sfera yang bercas positif *Atom is a positively charged sphere*
Ernest Rutherford (1871-1937)		(i) Menjumpai proton di dalam nucleus *Discovered protons in the nucleus* (ii) Jisim atom bertumpu di dalam nukleus *Atomic mass of atom is concentrated in the nucleus*

Neils Bohr (1885-1962)		Menjumpai elektron dalam atom bergerak pada ___petala___ mengelilingi nukleus *Discovered electrons in an atom moving in ___shells___ around the nucleus*
James Chadwick (1891-1974)		(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
Atomic Structure

Zarah Subatom
Subatomic Particles

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

2. neutral / *neutral*

3.

Atom *Atom*	**Bilangan proton** *Number of protons*	**Bilangan neutron** *Number of neutrons*	**Nombor proton** *Proton number*	**Nombor nukleon** *Nucleon number*
Karbon *Carbon*	6	6	6	12
Oksigen *Oxygen*	8	8	8	16
Klorin *Chlorine*	17	18	17	35

4. ion, proton / *ion, protons*

5.

Jenis zarah *Type of particle*	**Atom natrium, Na** *Sodium atom, Na*	**Ion natrium, Na^+** *Sodium ion, Na^+*
Bilangan proton *Number of proton*	11	11
Bilangan neutron *Number of neutron*	12	12
Bilangan elektron *Number of electron*	11	10

6.

(a) Nombor nukleon / *Nucleon number*

(b) Nombor proton / *Proton number*

$^{A}_{Z}X$ — Simbol unsur / *Symbol of element*

CONTOH 1

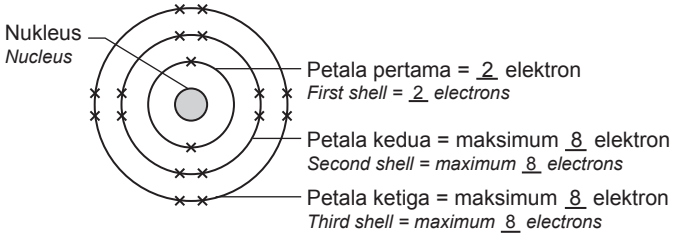
1. Nombor nukleon / *Nucleon number* = 31
Bilangan neutron / *Number of neutrons* = 16
Nombor proton / *Proton number* = 15
Bilangan elektron / *Number of electrons* = 15

2. Nombor nukleon / *Nucleon number* = 16
Bilangan neutron / *Number of neutrons* = 8
Nombor proton / *Proton number* = 8
Bilangan elektron / *Number of electrons* = 8

3. Nombor nukleon / *Nucleon number* = 14
Bilangan neutron / *Number of neutrons* = 7
Nombor proton / *Proton number* = 7
Bilangan elektron / *Number of electrons* = 7

4. Nombor nukleon / *Nucleon number* = 39
Bilangan neutron / *Number of neutrons* = 20
Nombor proton / *Proton number* = 19
Bilangan elektron / *Number of electrons* = 19

7. (a)

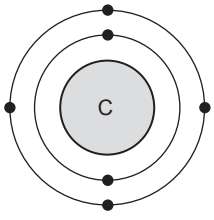
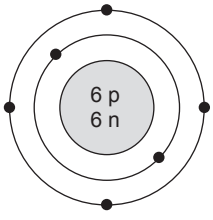


(b) valens / *valence*
(c) elektron valens / *valence electrons*
(d)

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

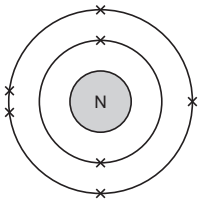
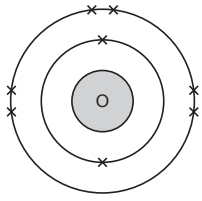
9. (a) nukleus / *nucleus*
(b) proton, neutron / *protons, neutrons*
(c) $^{12}_{6}C$

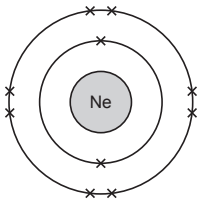
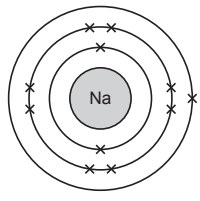
Bilangan neutron / *Number of neutrons* = 6
Bilangan proton / *Number of protons* = 6
Bilangan elektron / *Number of electrons* = 6
Susunan elektron / *Electron arrangement* = 2.4

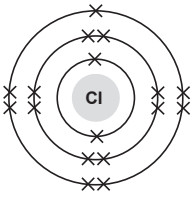
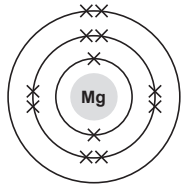
Rajah susunan elektron atom karbon *Electron arrangement of carbon atom diagram*	**Rajah struktur atom karbon** *Atomic structure of carbon atom diagram*
	

Tugasan 1

Lengkapkan jadual di bawah. TP3
Complete the table below.

Unsur *Element*	Nitrogen, *N* *Nitrogen, N*	**Unsur** *Element*	Oksigen, O *Oxygen, O*
Nombor proton *Proton number*	7	**Nombor proton** *Proton number*	8
Susunan elektron *Electron arrangement*	2.5	**Susunan elektron** *Electron arrangement*	2.6
Elektron valens *Valence electrons*	5	**Elektron valens** *Valence electrons*	6
			

Unsur *Element*	Neon, Ne *Neon, Ne*	**Unsur** *Element*	Natrium, Na *Sodium, Na*
Nombor proton *Proton number*	10	**Nombor proton** *Proton number*	11
Susunan elektron *Electron arrangement*	2.8	**Susunan elektron** *Electron arrangement*	2.8.1
Elektron valens *Valence electrons*	8	**Elektron valens** *Valence electrons*	1
			

Unsur *Element*	Klorin, CI *Chlorine, Cl*	**Unsur** *Element*	Magnesium, Mg *Magnesium, Mg*
Nombor proton *Proton number*	17	**Nombor proton** *Proton number*	12
Susunan elektron *Electron arrangement*	2.8.7	**Susunan elektron** *Electron arrangement*	2.8.2
Elektron valens *Valence electrons*	7	**Elektron valens** *Valence electrons*	2
			

2.3 Isotop dan Penggunaannya
Isotopes and Their Uses

1. proton, nukleon, neutron
protons, nucleons, neutrons

2. kelimpahan semula jadi
natural abundance

3. Jisim atom relatif klorin
Relative atomic mass of chlorine
$= \frac{(24 \times 79) + (25 \times 10) + (26 \times 11)}{100}$
$= 24.3$

Kegunaan Isotop
Uses of Isotopes

Bidang *Field*	Isotop *Isotope*	Kegunaan *Uses*
(a) Perubatan *Medical*	Kobalt-60 *Cobalt-60*	Untuk membunuh sel kanser tanpa pembedahan *To kill cancer* cancer *without surgery*
	Iodin-131 *Iodine-131*	Untuk merawat penyakit tiroid *To treats* thyroid *disorders*
(b) Pertanian *Agriculture*	Fosforus-32 *Phosphorus-32*	Untuk mengkaji metabolisme tumbuhan *To study plant* metabolism
(c) Nuklear *Nuclear*	Uranium-235 *Uranium-235*	Untuk menjana arus elektrik melalui jana kuasa nuklear *To generate* electricity *through the nuclear power generator*
(d) Arkeologi *Archaeology*	Karbon-14 *Carbon-14*	Untuk menganggar usia fosil dan artifak *To estimate the age of fossils and artefacts*
(e) Industri *Industry*	Hidrogen-3 *Hydrogen-3*	Pengesan untuk mengkaji air sisa *Detector to study wastewater*
(f) Kejuruteraan *Engineering*	Natrium-24 *Sodium-24*	Untuk mengesan kebocoran paip bawah tanah *To detect leaks in the underground* pipes

Praktis SPM 2

Soalan Objektif

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

Soalan Subjektif

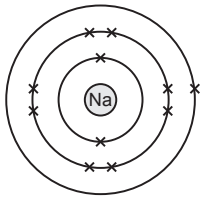
Bahagian A

1. (a) Jumlah bilangan proton dan neutron
Total number of protons and neutrons

(b) $^{27}_{13}Al$

(c) (i) 2.8
(ii) 2.8.4

(d) (i)



(ii) +1
(iii) Untuk mengesan kebocoran paip bawah tanah
To detect leakage in underground pipes

Bahagian B

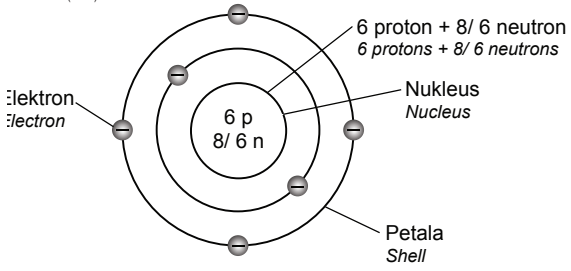
2. (a) (i) *T* : 2.8 *U* : 2.1 *V*: 2.4
(ii) *T* : 8 *U*: 1 *V*: 4
(iii) Unsur logam: *U*, unsur bukan logam: *V* / *T*
Metal element: U, non-metal element: V /T

(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 yang 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 yang berbeza *Different nucleon number* Sifat fizik yang berbeza *Different physical properties* [mana-mana dua jawapan] [*any two answers*]

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

(iii)



(c) 75% atom klorin-35 dan 25% atom klorin-37. Ini memberikan klorin jisim atom relatif sebanyak 35.5 (sebenarnya 35.4527 g/mol).
75% chlorine-35 atoms and 25% chlorine-37 atoms. This gives chlorine the relative atomic mass of 35.5 (actually 35.4527 g / mol).

Bahagian C

3. (a) A → B
Suhu menurun / *Temperature decreases*
Wujud dalam keadaan cecair
Exists in the liquid state
Zarah membebaskan haba dan bergerak perlahan
Particles releases heat and move slowly

B → C
Suhu malar / *Temperature is constant*
Wujud dalam keadaan cecair dan pepejal (pembekuan berlaku)
Exists in the liquid and solid states (freezing occurs)
Tenaga haba yang dibebaskan ke persekitaran diimbangi oleh tenaga haba yang terbebas apabila zarah menarik antara satu sama lain untuk membentuk pepejal
Heat energy released to the surroundings is balanced by the heat energy released when particles attract one another to form a solid

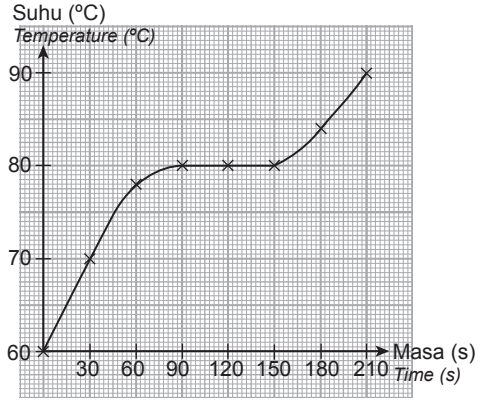
C → D
Suhu menurun / *Temperature decreases*
Wujud dalam keadaan pepejal
Exists in the solid state
Zarah membebaskan haba dan bergerak dengan lebih perlahan
Particles releases heat and move even more slowly

(b) Kesilapan: Aras sebatian *P* lebih tinggi daripada paras air di dalam bikar.
Tabung didih perlu direndamkan di bawah paras air.
The level of P compound is higher than the level of water in the beaker.
The boiling tube should be immersed lower than the water level.

Prosedur / ***Procedure:***

1. Isikan sebatian *P* ke dalam tabung didih sehingga satu pertiga penuh.
Fill compound P into a boiling tube until one third full.
2. Letakkan termometer ke dalam tabung didih.
Put a thermometer into the boiling tube.
3. Apitkan tabung didih di dalam kukus air. Panaskan air dan kacau sebatian *P* dengan perlahan menggunakan termometer.
Clamp the boiling tube in a water bath. Heat the water and stir compound P slowly using the thermometer.
4. Mulakan jam randik apabila suhu mencapai 60 °C.
Start the stopwatch when the temperature reaches 60 °C.
5. Rekodkan suhu sebatian *P* pada selang masa 30 s sehingga suhu mencapai 90 °C.
Record the temperature of compound P at 30 seconds intervals until the temperature reaches 90 °C.

Masa (s) ***Time (s)***	0	30	60	90	120	150	180	210
Suhu (°C) ***Temperature (°C)***	60	70	78	80	80	80	84	90



Praktis Ekstra SPM 2

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

Jawapan

Bab 3

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

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.

$$\text{JAR} = \frac{\text{Jisim purata satu atom unsur}}{\frac{1}{12} \times \text{jisim satu atom karbon-12}}$$

$$RAM = \frac{\textit{Average mass of one atom of an element}}{\frac{1}{12} \times \textit{mass of one carbon-12 atom}}$$

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

5.

$$\text{JMR} = \frac{\text{Jisim purata satu molekul}}{\frac{1}{12} \times \text{jisim satu atom karbon-12}}$$

$$RMM = \frac{\textit{Average mass of one molecule}}{\frac{1}{12} \times \textit{mass of one carbon-12 atom}}$$

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 × 2) + 16	94

Tugasan 1

1.

Bahan *Substance*	Formula molekul / Formula ion *Molecular formula / Ionic formula*	JMR / JFR *RMM / RFM*
(a) Gas klorin *Chlorine gas*	Cl_2	35.5 × 2 = 71
(b) Karbon dioksida *Carbon dioxide*	CO_2	12 + (16 × 2) = 44
(c) Ammonia *Ammonia*	NH_3	14 + (1 × 3) = 17
(d) Asid sulfurik *Sulphuric acid*	H_2SO_4	(1 × 2) + 32 + (16 × 4) = 98
(e) Kuprum(II) oksida *Copper(II) oxide*	CuO	64 + 16 = 80
(f) Zink klorida *Zinc chloride*	$ZnCl_2$	65 + (35.5 × 2) = 136
(g) Ferum(II) nitrat *Iron(II) nitrate*	$Fe(NO_3)_2$	56 + [14 + (16 × 3)] × 2 = 180
(h) Kalium manganat(VII) *Potassium manganate(VII)*	$KMnO_4$	39 + 55 + (16 × 4) = 158

2. $18x + 14 + 64 = 149$
$18x = 149 - 95$
$x = 3$

3.2 Konsep Mol
Mole Concept

1. kuantiti / *amount*

2. 6.02×10^{23} mol^{-1}

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

CONTOH 1

JFR ZnO / *RFM of ZnO* = 65 + 16
= 81

Jisim ZnO / *Mass of ZnO* = 1.5 × 81
= 121.5 g

CONTOH 2

JMR $MgCl_2$ / *RMM of* $MgCl_2$ = 24 + (2 × 35.5)
= 95

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

Bilangan Mol dan Isi Padu Gas
Number of Moles and Volume of Gases

1. satu / *one*

2. 24, 22.4 dm^3

Tugasan 2

1. (a) $2 \times 6.02 \times 10^{23} = 1.204 \times 10^{24}$ atom / *atoms*
(b) $2 \times 6.02 \times 10^{23} = 1.204 \times 10^{24}$ molekul / *molecules*
(c) $2 \times 2 \times 6.02 \times 10^{23} = 2.208 \times 10^{24}$ atom / *atoms*

2. (a) $n = \dfrac{4.55 \times 10^{24}}{6.02 \times 10^{23}}$
$= 7.558$ mol

(b) $n = \dfrac{6.5}{40 + 12 + 3(16)}$
$= 0.065$ mol

(c) $n = \dfrac{72}{24}$
$= 3.0$ mol

(d) $n = \dfrac{33.6}{22.4}$
$= 1.5$ mol

3. Bilangan atom bagi / *Number of atoms for*
24.0 g magnesium, Mg
24.0 g of magnesium, Mg
$\dfrac{24}{24} \times 6.02 \times 10^{23} = 6.02 \times 10^{23}$ atom / *atoms*

24.0 g natrium klorida, NaCl
24.0 g of sodium chloride, NaCl
$\dfrac{24}{(23 + 35.5)} \times 2 \times 6.02 \times 10^{23} = 4.94 \times 10^{23}$ atom / *atoms*

24.0 g gas helium, He
24.0 g of helium gas, He
$\dfrac{24}{24} \times 6.02 \times 10^{23} = 6.02 \times 10^{23}$ atom / *atoms*

Maka, NaCl mengandungi bilangan atom yang paling sedikit.
Thus, NaCl contains the smallest number of atoms.

3.3 Formula Kimia
Chemical Formulae

1. huruf, subskrip / *alphabets, subscripts*

2.

Formula kimia *Chemical Formula*

(a) Formula molekul *Molecular formula*

Formula yang menunjukkan bilangan sebenar atom setiap unsur dalam suatu sebatian

Formula that shows the actual number of atoms of each element in a compound

(b) Formula empirik *Empirical formula*

Formula yang menunjukkan nisbah ringkas bilangan atom setiap unsur dalam suatu sebatian

Formula that shows the simplest ratio for the number of atoms of each element in a compound

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

Penentuan Formula Empirik
Determination of Empirical Formula

CONTOH 3

Unsur / *Element*	Cu	Cl
Bilangan mol / *Number of moles*	$\frac{0.64}{64} = 0.01$	$\frac{0.71}{35.5} = 0.02$
Nisbah mol teringkas / *Simplest mole ratio*	1	2
Formula empirik / *Empirical formula*	$CuCl_2$	

CONTOH 4

Unsur / *Element*	Ca	Ca	O
Bilangan mol / *Number of moles*	$\frac{40}{40} = 10$	$\frac{12}{12} = 1.0$	$\frac{48}{16} = 3.0$
Nisbah mol teringkas / *Simplest mole ratio*	1	1	3
Formula empirik / *Empirical formula*	$CaCO_3$		

CONTOH 5

Unsur / *Element*	*P*	O
Bilangan mol / *Number of moles*	$\frac{5.4}{X}$	$\frac{4.8}{16} = 0.3$
Nisbah mol teringkas / *Simplest mole ratio*	2	3

$$\frac{5.4}{0.3x} = \frac{2}{3}$$
$$x = \frac{3}{2} \times \frac{5.4}{0.3}$$
$$x = 27$$

Pengiraan Formula Molekul
Calculation of Molecular Formula

CONTOH 6

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

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

CONTOH 7

$(CH_2O)_n = 180$
$[12 + (2 \times 1) + 16]_n = 180$
$30_n = 180$
Formula molekul = $(CH2O)_6 = C_6H_{12}O_6$
Molecular formula

Eksperimen 3.1

Mentafsir data / *Interpreting data*:

Unsur *Element*	Mg	O
Jisim unsur (g) *Mass of element (g)*	21.00 – 16.20 = 4.8	24.20 – 21.00 = 3.2
Bilangan mol *Number of moles*	$\frac{4.8}{24} = 0.2$	$\frac{3.2}{16} = 0.2$
Nisbah mol teringkas *Simplest mole ratio*	1	1
Formula Empirik *Empirical formula*	MgO	

Perbincangan / *Discussion*:

1. Untuk menyingkirkan lapisan oksida
   To eliminate the oxide layer
2. Untuk membenarkan oksigen/ udara masuk
   To allow oxygen/ air to enter
3. Magnesium oksida / *Magnesium oxide*

Kesimpulan / *Conclusion*:

Formula empirik bagi magnesium oksida ialah MgO.
The empirical formula of magnesium oxide is MgO.

Eksperimen 3.2

Mentafsir data / *Interpreting data*:

Unsur *Element*	Cu	O
Jisim unsur (g) *Mass of element (g)*	28.2 – 25.0 = 3.2	29.0 – 28.2 = 1.2
Bilangan mol *Number of moles*	$\frac{3.2}{6.4} = 0.05$	$\frac{0.8}{16} = 0.05$
Nisbah mol teringkas *Simplest mole ratio*	1	1
Formula empirik *Empirical formula*	CuO	

Perbincangan / *Disussion*:

1. Untuk bertindak balas bagi menghasilkan gas hidrogen
   To react in order to produce hydrogen gas
2. Untuk memastikan semua kuprum(II) oksida telah bertukar kepada kuprum
   To make sure that all copper(II) oxide has turned to copper
3. Perang / *Brown*

Kesimpulan / *Conclusion*:
Formula empirik bagi kuprum(II) oksida ialah CuO.
The empirical formula of copper(II) oxide is CuO.

Formula Kimia bagi Sebatian Ion
Chemical Formulae for Ionic Compounds

Kation *Cation*	Anion *Anion*	Jumlah cas *Total charge*	Formula kimia *Chemical formula*
Mg^{2+}	O^{2-}	(+2) + (–2) = 0	MgO
Mg^{2+}	Cl^{-}	(+2) + 2(–1) = 0	$MgCl_2$
Mg^{2+}	CO_3^{2-}	(+2) + (–2) = 0	$MgCO_3$
Mg^{2+}	NO_3^{-}	(+2) + 2(–1) = 0	$Mg(NO_3)_2$
Mg^{2+}	SO_4^{2-}	(+2) + (–2) = 0	$MgSO_4$
Mg^{2+}	OH^{-}	(+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*	Ca^{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(VI) ion*	$Cr_2O_7^{2-}$

2.

	Sebatian ***Compound***	**Formula** ***Formula***		**Sebatian** ***Compound***	**Formula** ***Formula***
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.

	Sebatian ***Compound***	**Formula** ***Formula***		**Sebatian** ***Compound***	**Formula** ***Formula***
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

Penamaan Sebatian Kimia
Naming of Chemical Compounds

Tugasan 4

1.

Sebatian *Compound*	Nama *Name*	Sebatian *Compound*	Nama *Name*
(a) $MgCl_2$	Magnesium klorida *Magnesium chloride*	(e) K_2SO_4	Kalium sulfat *Potassium sulphate*
(b) $FeSO_4$	Ferum(II) sulfat *Iron(II) sulphate*	(f) $ZnCO_3$	Zink karbonat *Zinc carbonate*
(c) $CaCO_3$	Kalsium karbonat *Calsium carbonate*	(g) NH_4Cl	Ammonium klorida *Ammonium chloride*
(d) $Zn_3(PO_4)_2$	Zink fosfat *Zinc phosphate*	(h) $K_2S_2O_3$	Kalium tiosulfat *Potassium thiosulphate*

2.

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

3.4 Persamaan Kimia
Chemical Equations

Cara Menulis Persamaan Kimia
How to Write a Chemical Equation

CONTOH 8

1. Tulis persamaan dalam perkataan. *Write the equation in words.*	Natrium *Sodium* + Gas oksigen *Oxygen gas* → Natrium oksida *Sodium oxide*
2. Tulis formula kimia bagi bahan dan hasil tindak balas. *Write the chemical formula for the reactants and the products.*	$Na + O_2 \rightarrow Na_2O$
3. Semak sama ada persamaan kimia seimbang. *Check if the chemical equation is balanced.*	Tidak seimbang *Not balanced*
4. Imbangkan persamaan dengan mengubah pekali di hadapan formula kimia. *Balance the equation by adjusting the coeficients in front of the chemical formula.*	$\underline{4}\,Na + O_2 \rightarrow \underline{2}\,Na_2O$
5. Tuliskan keadaan fizik bagi setiap bahan dan hasil tindak balas (jika perlu). *Write the physical state for each reactant and product (if required).*	$\underline{4}\,Na(p) + O_2(g) \rightarrow \underline{2}\,Na_2O(p)$ $Na(s) + O_2(g) \rightarrow \underline{2}\,Na_2O(s)$

Menggunakan Persamaan Kimia
Using Chemical Equation

CONTOH 9

Aspek kualitatif ialah / *Qualitative aspects are*:
(i) Magnesium, oksigen / *Magnesium, oxygen*
(ii) Magnesium oksida / *Magnesium oxide*
(iii) pepejal, gas, pepejal / *solid, gas, solid*

Aspek kuantitatif ialah pekali yang menunjukkan:
Quantitative aspects are the coefficients that show:
(i) 2, 1, 2
(ii) 2, 1, 2

Tugasan 5

(a) $HCl + KOH \text{ ---> } KCl + H_2O$
(b) $4Na + O_2 \text{ ---> } 2Na_2O$
(c) $2HCl + Zn \text{ ---. } ZnCl_2 + H_2$
(d) $AgNO_3 + KCl \text{ ---> } AgCl + KNO_3$
(e) $Mg + CuO \text{ ---> } MgO + Cu$

Tugasan 6

1. (a) $CaCO_3 \rightarrow CaO + CO_2$
(b) Bilangan mol $CaCO_3$
Number of moles of $CaCO_3$
$= \frac{20}{100} = 0.2$ mol

1 mol $CaCO_3$ menghasilkan 1 mol CO_2
1 mole of $CaCO_3$ produces 1 mole of CO_2
Maka, 0.2 mol $CaCO_3$ menghasilkan 0.2 mol CO_2
So, 0.2 mole of $CaCO_3$ produces 0.2 mole of CO_2

Isi padu CO_2 / *Volume of CO_2*
$= 0.2 \times 24$
$= 4.8 \text{ dm}^3$

2. Bilangan mol MgO
Number of moles of MgO
$= \frac{80}{40} = 2$ mol

1 mol MgO menghasilkan 1 mol $Mg(NO_3)_2$
1 mole of MgO produces 1 mole of $Mg(NO_3)_2$
Maka, 2 mol MgO menghasilkan 2 mol $Mg(NO_3)_2$
So, 2 moles of MgO produce 2 moles of $Mg(NO_3)_2$

Jisim $Mg(NO_3)_2$ / *Mass of $Mg(NO_3)_2$*
$= 2 \times [24 + (2 \times 14) + (2 \times 3 \times 16)]$
$= 296$ g

Praktis SPM 3

Soalan Objektif

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

Soalan Subjektif

Bahagian A

1. (a) Jisim purata satu atom unsur berbanding dengan $\frac{1}{12}$ kali jisim satu atom karbon-12
The average mass of one atom of an element compared to $\frac{1}{12}$ of the mass of one carbon-12 atom
(b) Mudah dikendalikan // Mudah dijumpai
Easy to be handled // Readily found
(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 mole of Mg reacts with 1 mole of Cl_2 to produce 1 mole of $MgCl_2$
(iii) $n = \frac{2.4}{24}$
$= 0.1$

Nisbah mol	Mg :	Cl_2
Mole ratio	0.1	0.1

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

2. (a) Karbon dan oksigen / Carbon and oxygen
(b) (i) Formula kimia yang menunjukkan bilangan sebenar atom setiap unsur yang terdapat di dalam satu molekul sesuatu sebatian
The chemical formula that shows the actual number of atoms of each element found in a molecule of a compound
(ii) C_2H_5
(iii) Kerana nisbah karbon, C kepada oksigen, O adalah paling ringkas iaitu 1:1
Because the ratio of carbon, C to oxygen, O is the simplest that is 1:1
(c) $(12 + 2 + 16)n = 60$
$n = 2$
Formula molekul / *Molecular formula* = $C_2H_4O_2$

Bahagian B

3. (a) (i) Formula molekul ialah formula kimia yang menunjukkan bilangan sebenar atom setiap unsur dalam satu molekul suatu sebatian.
Molecular formula is the chemical formula that shows the actual number of atoms of each element in one molecule of 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 tindak balas ialah $C_6H_{12}O_6$ dan O_2
The reactants are $C_6H_{12}O_6$ and O_2

– Hasil tindak balas ialah CO_2 dan H_2O
The 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 of* $K_2O = 94$
Nisbah mol, *Mole ratio* $4K : 2K_2O$
$2K : K_2O$
$n = \frac{19.5}{39}$
$= 0.5$ mol
Maka / *So* $2K : K_2O$
$0.5K : 0.25\ K_2O$
Jisim / *Mass of* $K_2O = 0.25 \times 94$
$= 23.5$ g

Bahagian C

4. (a) *Y* : Air kapur / *Lime water*
Menjadi keruh. Menunjukkan kehadiran gas karbon dioksida
Becomes cloudy. Shows the presence of carbon dioxide gas

(b) *X* : Gas karbon dioksida / *Carbon dioxide gas*
$CuCO_3 \rightarrow CuO + CO_2$
Bilangan mol $CuCO_3$
Number of moles of $CuCO_3$
$= \frac{24.8}{124} = 0.2$ mol
1 mol $CuCO_3$ menghasilkan 1 mol CuO
1 mole of $CuCO_3$ produces 1 mole of CuO
Maka, 0.2 mol $CuCO_3$ menghasilkan 0.2 mol CuO
So, 2 mole of $CuCO_3$ produce 0.2 mole of CuO
Jisim CuO / *Mass of CuO*
$= 0.2 \times 80$
$= 16.0$ g

(c) Bahan tindak balas ialah asid hidroklorik dan ammonia.
Hasil tindak balas ialah ammonium klorida.
The reactants are hydrochloric acid and ammonia.
The product is ammonium chloride.

(d) (i) Susunan radas A / *Apparatus set-up A*
Mempunyai penutup. Tanpa penutup, wasap putih atau magnesium oksida akan terbebas
Has a lid. Without a lid, the white fumes or magnesium oxide will escape

(ii) Bersihkan pita magnesium dengan kertas pasir. Untuk menyingkirkan lapisan oksida
Buka dan tutup penutup dengan cepat. Membenarkan oksigen masuk untuk melengkapkan tindak balas
Ulang proses pemanasan, penyejukan dan penimbangan pita magnesium. Untuk mendapatkan jisim yang tetap
Clean the magnesium ribbon with sandpaper. To remove the oxide layer
Open and close the lid quickly. Allowing oxygen to enter in order to complete the reaction
Repeat the process of heating, cooling, and weighing of the magnesium ribbon. To obtain a constant mass

Praktis Ekstra SPM 3

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

Jawapan

Bab 4

Bab 4

Jadual Berkala Unsur
The Periodic Table of Elements

4.1 Perkembangan Jadual Berkala Unsur
The Development of the Periodic Table of Elements

Sejarah Perkembangan Jadual Berkala Unsur
Historical Development of the Periodic Table of Elements

Ahli sains *Scientist*	Sumbangan *Contribution*
1. Antoine Lavoisier	Mengelaskan unsur-unsur kepada kumpulan yang terdiri daripada gas, logam, bukan logam dan oksida logam *Classified the elements to groups consist of gas, metals, non-metals and metal oxides*
2. Johann W. Dobereiner	Membina 'triad' iaitu kumpulan yang mengandungi tiga unsur dengan sifat-sifat kimia yang sama *Build a 'triad' which is a group that consists of three elements with the same chemical properties*
3. John Newlands	Menyusun unsur-unsur mengikut pertambahan jisim atom dan menamakan penyusunan itu sebagai Hukum Oktaf *Arranged the elements according to increasing atomic mass and named the arrangement as Law of Octaves*
4. Lothar Meyer	Melakarkan graf isi padu atom melawan jisim atom bagi unsur-unsur *Plotted the graph of atomic volume against atomic mass of the elements*
5. Dmitri Mendeleev	• Menysusun unsur-unsur mengikut pertambahan jisim atom *Arranged the elements according to increasing atomic mass* • Unsur-unsur dengan sifat kimia yang sama disusun dalam lajur menegak yang sama *Elements with similar chemical properties were arranged in the same vertical column* • Meninggalkan ruang kosong bagi unsur-unsur yang belum ditemui *Leaves gaps for undiscovered elements*
6. Henry Mosely	Mengelaskan unsur berdasarkan konsep nombor proton dan unsur disusun mengikut tertib menaik nombor proton *Classified elements based on the concept of proton number and the elements were arranged in order of increasing proton number*

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

Penyusunan Unsur dalam Jadual Berkala Unsur
Arrangement of Elements in the Periodic Table of Elements

1. nombor proton / *proton number*
2. Kumpulan, elektron valens / *Groups, valence electrons*

3.

Bilangan elektron valens *Number of Valence electrons*	**Kumpulan** *Group*	**Contoh** *Example*
1 – 2	Bilangan elektron valens *Number of valence electron*	2 elektron valens = Kumpulan 2 *2 valence electrons = Group* 2
3 – 8	10 + bilangan elektron valens *10 + number of valence electrons*	7 elektron valens = Kumpulan 17 *7 valence electrons = Group* 17

4. kimia / *chemical*

5. Kala, petala / *Periods, shells*

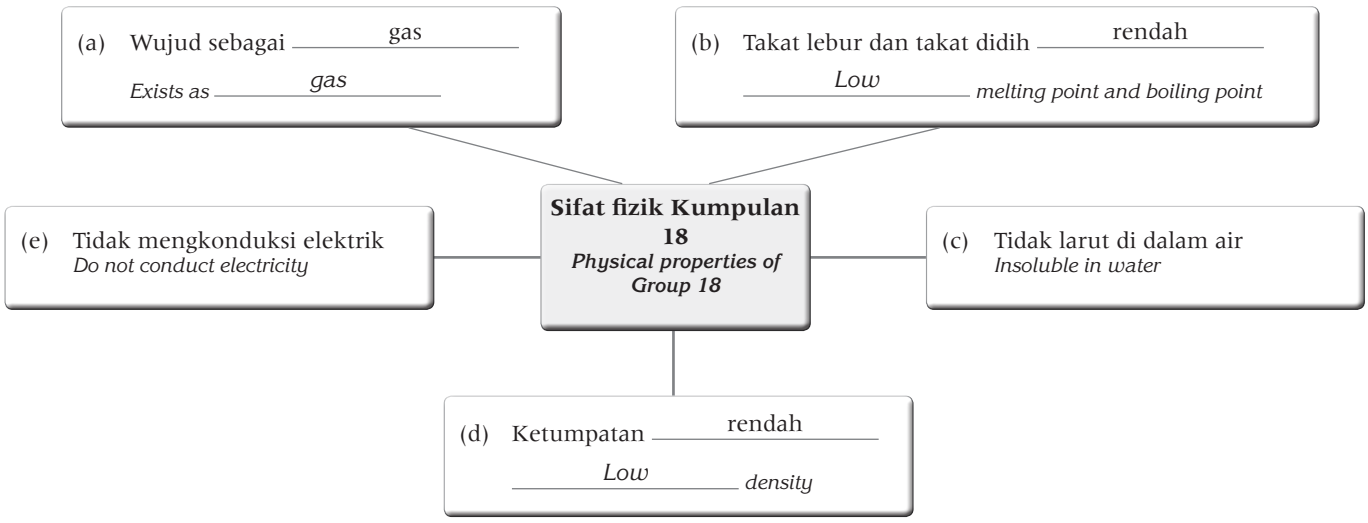
Tugasan 1

Unsur *Element*	**Nombor proton** *Proton number*	**Susunan elektron** *Electron arrangement*	**Elektron valens** *Valence electron*	**Kumpulan** *Group*	**Kala** *Period*
Litium *Lithiun*	3	2.1	1	1	2
Karbon *Carbon*	6	2.4	4	14	2
Oxygen *Oxygen*	8	2.6	6	16	2
Neon *Neon*	10	2.8	8	18	2
Magnesium *Magnesium*	12	2.8.2	2	2	3
Aluminium *Aluminium*	13	2.8.3	3	13	3
Kalium *Potassium*	19	2.8.8.1	1	1	4
Kalsium *Calcium*	20	2.8.8.2	2	2	4
Fosforus *Phosphorus*	15	2.8.5	5	15	3
Fluorin *Fluorine*	9	2.7	7	7	2

4.3 Unsur dalam Kumpulan 18
Elements in Group 18

1. (b) adi / *noble*
(c) monoatom / *monoatoms*
(d) duplet, oktet, menerima
*duplet, octet, accep*t

2.



Perubahan Sifat Fizik apabila Menuruni Kumpulan 18
Changes in Physical Properties when Going Down Group 18

1. bertambah / *increases*

2. bertambah, kuat, haba / *increases, increases, heat*

3. bertambah / *Increases*

Kegunaan Unsur-unsur Kumpulan 18
Uses of Group 18 Elements

Unsur *Element*	Kegunaan *Uses*
1. Helium *Helium*	Mengisi belon kaji cuaca dan tangki oksigen untuk penyelam *Fills weather balloons and oxygen tank for divers*
2. Neon *Neon*	Mengisi lampu untuk papan iklan *Fills lamps for advertising boards*
3. Argon *Argon*	Mengisi mentol elektrik *Fills electrical bulbs*
4. Krypton *Kripton*	Mengisi lampu denyar kilat pada kamera *Fills camera flash light*
5. Xenon *Xenon*	Sebagai ubat bius dalam perubatan *As anaesthetics in medicine*
6. Radon *Rado*	Merawat kanser *Treatment of cancer*

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*

Perubahan Sifat Fizik Unsur apabila Menuruni Kumpulan 1
Changes in Physical Properties of Elements when Going Down Group 1

1. bertambah / *increases*
2. berkurang, lemah / *decrease, weaker*
3. bertambah / *increases*

Sifat Kimia Unsur Kumpulan 1
Chemical Properties of Group 1 Elements

1. sama, satu / *same, one*
2. 1, duplet, oktet, 1, positif / *1, duplet, octet, 1, positively*
3. (a) 1. cergas, beralkali, hidrogen / *actively, an alkaline, hydrogen*
2. $2X\text{OH(ak)}$, $H_2(g)$ / *2XOH(aq), $H_2(g)$*
(b) 1. cergas, oksida / *actively, oxide*
$2X_2\text{O(p)}$ / *$2X_2O(s)$*
2. beralkali / *alkaline*
$2X\text{OH(ak)}$ / *2XOH(aq)*
(c) 1. logam klorida / *metal chloride*
$2X\text{Cl(p)}$ / *2XCl(s)*

Perubahan Kereaktifan Unsur apabila Menuruni Kumpulan 1
Changes in Reactivity of Elements when Going Down Group 1

1. bertambah / *increases*
2. jauh / *further*
3. lemah / *weaker*
4. mendermakan, ion positif / *donate, positive ion*

Eksperimen 4.1

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, 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 OF alkali metals with water*	Keraktifan logam alkali dengan oksigen *Reactivity of alkali metals with oxygen*	Keraktifan logam alkali dengan klorin *Reactivity of 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*

Keputusan / ***Results:***

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:* $K_2O(s) + H_2O(l) \longrightarrow 2KOH(aq)$

C

Unsur *Element*	Pemerhatian *Observation*
Litium *Lithium*	Litium terbakar perlahan. Pepejal putih terhasil. *Lithium burns slowly. White solid is produced.* Persamaan kimia: $2Li(p) + Cl_2(g) \longrightarrow 2LiCl(p)$ *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: $2Na(p) + Cl_2(g) \longrightarrow 2NaCl(s)$ *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: $2K(p) + Cl_2(g) \longrightarrow 2KCl(p)$ *Chemical equation:* $2K(s) + Cl_2(g) \longrightarrow 2KCl(s)$

Perbincangan / *Discussion*:

1. beralkali, hidrogen / *alkaline, hydrogen*
2. oksida, larut / *oxide, dissolves*
3. klorida / *chloride*
4. sifat kimia / *chemical*
5. litium, natrium, kalium / *lithium, sodium, potassium*

Kesimpulan / *Conclusion*:

bertambah / *increases*

4.5 Unsur dalam Kumpulan 17
Elements in Group 17

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

Perubahan Sifat Fizik Unsur apabila Menuruni Kumpulan 17
Changes in Physical Properties of Elements when Going Down Group 17

1. bertambah / *increases*
2. bertambah, atom, kuat, haba
increases, atomic, stronger, heat
3. bertambah / *increases*

Sifat Kimia Unsur Kumpulan 17
Chemical Properties of Group 17 Elements

1. sama / *same*
2. duplet, oktet, negatif / *duplet, octet, negatively*

3.

A

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 perang kemerahan. 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 :* $I_2(s) + H_2O(l) \longrightarrow HI(aq) + HOI(aq)$

B

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: $2Fe(p) + 3Cl_2(g) \longrightarrow 2FeCl_3(p)$ *Chemical equation :* $2Fe(s) + 3Cl_2(g) \longrightarrow 2FeCl_3(s)$
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. Pepejal perang terhasil. *Iron wool glows dimly. Brown solid is produced.* Persamaan kimia: $2Fe(p) + 3I_2(g) \longrightarrow 2FeI_3(p)$ *Chemical equation :* $2Fe(s) + 3I_2(g) \longrightarrow 2FeI_3(s)$

C

Unsur *Element*	Pemerhatian *Observation*
Klorin *Chlorine*	Gas kuning kehijauan larut dengan mudah di dalam larutan natrium hidroksida menghasilkan larutan tidak berwarna. *Greenish yellow gas dissolves easily in sodium hydroxide solution to produce a colourless solution.* Persamaan kimia: $Cl_2(g) + 2NaOH(ak) \longrightarrow NaCl(ak) + NaOCl(ak) + H_2O(ce)$ *Chemical equation :* $Cl_2(g) + 2NaOH(aq) \longrightarrow NaCl(aq) + NaOCl(aq) + H_2O(l)$
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, acidic solution, bleaching, dissolves*

2. halida / *halide*

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

4. iodin, bromin, klorin / *iodine, bromine, chlorine*

Kesimpulan / *Conclusions:*

berkurang / *decreases*

Perubahan Kereaktifan Unsur apabila Menuruni Kumpulan 17
Changes in Reactivity of Elements when Going Down Group 17

1. berkurang / *decreases*
2. jauh / *further*
3. satu, lemah / *one, weaker*
4. ion negatif / *negative ion*

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*

Perubahan Sifat Fizik Unsur apabila Merentasi Kala 3
Changes in Physical Properties of Elements when Going Across Period 3

1. berkurangan, kecil / *decreases, smaller*
2. (a) bertambah / *increase*
(b) terluar / *outermost*
(c) bertambah / *increases*

Perubahan Sifat Kimia Oksida Unsur Merentasi Kala 3
Changes in Physical Properties of Oxides of Elements Across Period 3

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 di 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

Hipotesis / *Hypothesis*:
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
Tindak balas dengan air *Reaction 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*

Keputusan / *Results*:

Oksida *Oxide*	**Pemerhatian** *Observation*	
	Larutan natrium hidroksida *Sodium hydroxide solution*	**Asid nitrik** *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*
Silikon(IV) oksida / *Silicon(IV) oxide*

2. garam, air / *salt, water*

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

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

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

4. garam, air / *salt, water*

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

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

Kegunaan Unsur Separa Logam
Uses of Semi-metallic Elements

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

2. silikon, Si, germanium, Ge, tinggi
silicon, Si, germanium, Ge, high

3. komputer, telefon bimbit / *computers, mobile phones*

Tugasan 2

1. (a) Si: 2.8.4 P: 2.8.5

(b) Kala 3. Mempunyai 3 petala berisi elektron
Period 3. Have 3 shells filled with electrons

(c) Aluminium, Al_2O_3

(d) Semakin berkurang. Cas positif di dalam nukleus semakin bertambah. Tarikan nukleus terhadap elektron valens semakin kuat. Saiz atom menjadi kecil.
Decreases. The positive charge in the nucleus increases. The force of attraction towards the valence electrons becomes stronger. The atomic size becomes smaller.

2. (a)

Natrium *Sodium*	**Perkara** *Description*	**Klorin** *Chlorine*
11	Nombor proton *Proton number*	17
2.8.1	Susunan elektron *Electron arrangement*	2.8.7
Pepejal *Solid*	Keadaan fizik *Physical state*	Gas *Gas*

(b) Atom natrium menderma satu elektron dan menghasilkan ion positif.
Sodium atom donates one electron and produces a positive ion.

(c) Kumpulan 17. Klorin mempunyai tujuh elektron valens.
Group 17. Chlorine has seven valence electrons.

(d) (i) Pepejal natrium melarut, bergerak bebas dan mengeluarkan bunyi 'hiss'.
Solid sodium dissolves, moves freely and gives out hissing sounds.

(ii) $2Na + 2H_2O \rightarrow 2NaOH + H_2$

4.7 Unsur Peralihan
Transition Elements

Kedudukan Unsur Peralihan
Position of Transition Elements

1. 3, 12

2.

Sifat-sifat fizik unsur peralihan
Physical properties of transition elements

(a) Pepejal permukaan kilat
Shiny surface solids

(b) Konduktor elektrik dan haba yang baik
Good conductors of electricity and heat

(c) Takat lebur dan takat didih yang tinggi
High melting point and boiling point

(d) Ketumpatan tinggi
High density

(e) Sangat keras, mulur dan mudah ditempa
Very hard, ductile and malleable

Ciri-ciri Istimewa Unsur Peralihan
Special Characteristics of Transition Elements

1. mangkin / *catalysts*
2. berwarna / *coloured*
3. nombor pengoksidaan / *oxidation number*
4. ion kompleks / *complex ions*

Kegunaan Unsur Peralihan dalam Industri
Uses of Transition Elements in Industry

Mangkin *Catalyst*	Industri *Industry*
1. Serbuk besi, Fe *Iron powder, Fe*	Penghasilan ammonia dalam proses Haber *Production of ammonia in Haber process*
2. Vanadium(V) oksida, V_2O_5 *Vanadium(V) oxide, V_2O_5*	Penghasilan asid sulfurik dalam proses Sentuh *Production of sulphuric acid in Contact process*
3. Platinum, Pt *Platinum, Pt*	Penghasilan asid nitrik dalam proses Ostwald *Production of nitric acid in Ostwald process*
4. Nikel *Nickel*	Pembuatan marjerin (penghidrogenan) *Manufacture of margarine (hydrogenation)*

Praktis SPM 4

Soalan Objektif

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

Soalan Subjektif

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 of attraction between the nucleus and valence electrons is weaker. Valence electrons electron are easier to be donated.

2. (a) (i) Kala 3 / *Period 3*
(ii) Halogen / *Halogens*
(iii) S^-
(b) Logam natrium kurang reaktif daripada logam kalium
Sodium metal is less reactive than potassium metal
(c) 2Na + S2 → 2NaS

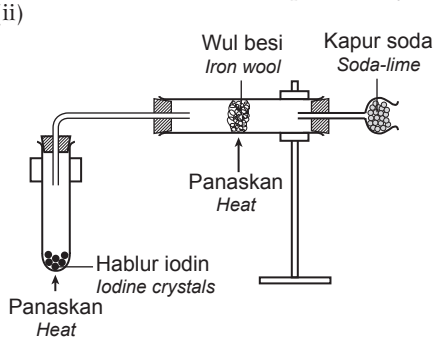
Bahagian B

3. (a) Karbon terletak dalam Kala 2 dan Kumpulan 14 dalam Jadual Berkala Unsur.
Karbon mempunyai 6 proton dan susunan elektronnya ialah 2.4.
Carbon is located in Period 2 and Group 14 in the Periodic Table of Elements. Carbon has 6 protons and its 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-duanya mempunyai bilangan elektron valens yang sama.
Electron arrangement for P = 2.8.2, Q = 2.8.8.2
Number of valence electrons for P = 2, Q = 2
So, P and Q have the same chemical properties because both have the same number of valence electrons.
(c) (i) – Permukaan berkilat / *Shiny surface*
– Konduktor 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:
Chemical equation:
$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$
(d) (i) Klorin lebih reaktif
Saiz atom klorin lebih kecil
Jarak antara nukleus dengan elektron valens lebih dekat
Kekuatan nukleus untuk menarik satu elektron ke dalam petala adalah lebih kuat

Chlorine is more reactive.
The atomic size of chlorine is smaller,
The distance between the nucleus and valence electrons is nearer
The strength of the nucleus to attract one electron into the outermost shell is stronger

$$2Fe + 3Cl_2 \rightarrow 2FeCl_3$$

(ii)



Bahagian C

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

(ii) *P*: Sulfur dioksida, *M*: Aluminium oksida, *Q*: Magnesium oksida
P: Sulphur dioxide, M: Aluminium oxide, Q: Magnesium oxide

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

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

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

(iii) Kertas biru lembap menjadi merah kemudian dilunturkan / *Blue litmus paper turns red then bleached*
Larutan berasid dan peluntur terhasil / *Acidic solution and bleach are produced*

(c) Saiz atom berkurang kerana jejari atom semakin berkurang.
Keelektronegatifan bertambah.
Pertambahan bilangan proton merentasi Kala 3 menyebabkan cas dalam nukleus bertambah.
Daya tarikan nukleus terhadap elektron semakin bertambah.
The atomic size decreases because the atomic radius reduces.
The electronegativity increases.
The increase in the number of protons across Period 3 causes the charge in the nucleus of the atom to increase.
The nuclear force of attraction towards the electrons increases.

Praktis Ekstra SPM 4

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

Jawapan

Bab 5

Bab 5 Ikatan Kimia
Chemical Bond

5.1 Asas Pembentukan Sebatian
Basics of Compound Formation

Pembentukan Ikatan Kimia
Formation of Chemical Bond

1. duplet, oktet, pemindahan, perkongsian
duplet, octet, transfer, share
2. ion, kovalen / *ionic, covalent*

5.2 Ikatan Ion
Ionic Bond

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

Pembentukan Ion Positif (Kation)
Formation of Positive Ion (Cation)

1. 2.8.1, satu, 2.8
2.8.1, one, 2.8
2. Na^+
$Na^+ + e^-$

Pembentukan Ion Negatif (Anion)
Formation of Negative Ion (Anion)

1. 2.8.7, tujuh, satu, 2.8.8
2.8.7, seven, one, 2.8.8
2. Cl^-
$e^- \rightarrow cl^-$
3. (a) Susunan elektron: 2.8.1
Electron arrangement

Cas 11 proton *Charge of 11 protons*	= +11
Cas 11 elektron *Charge of 11 electrons*	= –11
Jumlah cas *Total charge*	= 0

(b) Susunan elektron: 2.8
Electron arrangement

Cas 11 proton *Charge of 11 protons*	= +11
Cas 10 elektron *Charge of 10 electrons*	= –10
Jumlah cas *Total charge*	= –1

Pembentukan Ikatan Ion
Formation of Ionic Bond

1.

Susunan elektron / *Electron arrangement*			
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

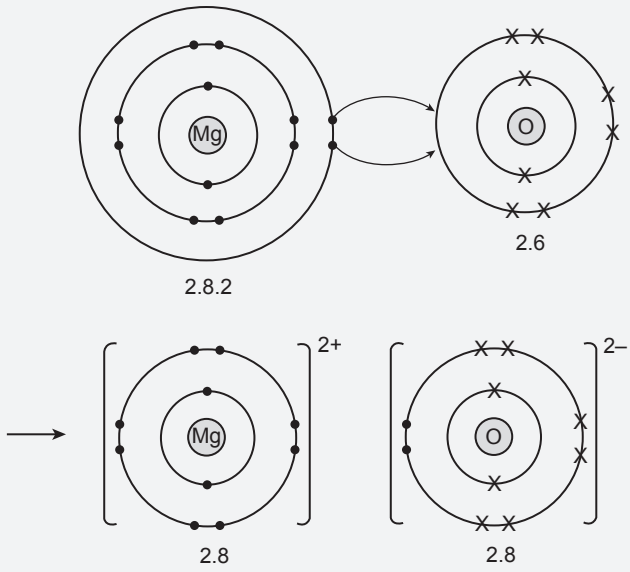
1. (a)

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

Persamaan setengah: $Mg \rightarrow$ ___Mg^{2+}___ + ___$2e^-$___
Half-equation:
$O +$ ___$2e^-$___ $\rightarrow$ ___O^{2-}___

Daya tarikan elektrostatik yang kuat antara Mg^{2+} dan O^{2-} menghasilkan ___MgO___.
Strong electrostatic attraction force between Mg^{2+} and O^{2-} produces ___MgO___.

(b)



5.3 Ikatan Kovalen
Covalent Bond

1. bukan logam, kovalen / *non-metal, covalent*
2. berkongsi, oktet, kovalen / *share, octet, covalent*

Pembentukan Ikatan Kovalen
Formation of Covalent Bond

1. 1, satu, 2 / *1, one, 2*
2. 2.8.7, tujuh, 2.8.8 / *2.8.7, seven, 2.8.8*

3.

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

Jenis-jenis Ikatan Kovalen
Types of Covalent Bond

1. (a) satu / *one*
(b) dua / *two*
(c) tiga / *three*
2. terluar / *outermost*

Perbandingan antara Ikatan Ion dengan Ikatan Kovalen
Comparison between Ionic Bond and Covalent Bond

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 atom logam dengan atom bukan logam *Between metal atom and non-metal atom*	Atom mencapai susunan elektron duplet atau oktet yang stabil *Atoms achieve the stable duplet or octet electron arrangements*	(b) Antara atom bukan logam dengan atom bukan logam *Between non-metal atom and non-metal atom*
(c) Membentuk ion positif dan ion negatif *Form positive ion and negative ion*		(c) Membentuk molekul *Form molecules*

Tugasan 2

1. (a) satu, duplet / *one, duplet*
tujuh, oktet / *seven, octet*
dikongsi, tunggal, Molekul / *shared, single, molecule*
(b) satu, menderma, oktet, Ion / *one, donate, octet, ion*
tujuh, menerima, oktet, Ion / *seven, receive, octet, ion*
tertarik, elektrostatik, ion / *attracted, electrostatic, ionic*

2. – Hanya melibatkan elektron valens
Only involve valence electrons
– Atom-atom mencapai susunan elektron duplet atau oktet yang stabil
Atoms achieved the stable duplet or octet electron arrangement

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.

Pembentukan Ikatan Hidrogen
Formation of Hydrogen Bond

1. berkongsi, kovalen, duplet, 2 , oktet, 2.8
shares, covalent, duplet, 2, octet, 2.8
2. keelektronegatifan, daya / *electronegativity, force*
3. hidrogen */ hydrogen*

Peranan Ikatan Hidrogen dalam Kehidupan Harian
Role of Hydrogen Bond in Daily Life

1. basah / *Wet*

Kesan Ikatan Hidrogen ke atas Sifat Fizik Bahan
Effect of Hydrogen Bond on the Physical Properties of Substances

2. lemah, antara molekul, kuat, tinggi
weaker, intermolecular, stronger, higher
3. ammonia, etanol, hidrogen, air, elektronegatif
ammonia, ethanol, hydrogen, water, electronegative
4. tinggi, hidrogen, haba
higher, hydrogen, heat

5.5 Ikatan Datif
Dative Bond

1. koordinat, elektron, satu
coordinate, electrons, one
2. ammonium, hidroksonium
ammonium, hydroxonium

Pembentukan Ikatan Datif
Formation of Dative Bond

1. Tiga, berkongsi, kovalen, duplet, oktet
Three, share, covalent, duplet, octet
2. pasangan elektron bebas, datif, ammonium
lone pair of electrons, 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 Compounds and Covalent Compounds

1.

Sebatian ion *Ionic compound*	**Sebatian kovalen** *Covalent compound*
Kekonduksian elektrik *Electrical conductivity*	
(a) Mengkonduksi elektrik dalam keadaan leburan dan larutan akueus *Conducts electricity in molten state and aqueous solution* (b) Sebab: Mempunyai ion yang bebas bergerak *Reason: Has freely moving ions*	(c) Tidak mengkonduksi elektrik dalam sebarang keadaan *Does not conduct electricity in any forms* (d) Sebab: Terdiri daripada molekul neutral yang tidak membawa cas *Reason: Consists of neutral molecules that do not carry charges*

Keterlarutan di dalam air dan pelarut organik ***Solubility in water and organic solvents***	
(e) Larut di dalam air, tidak larut di dalam pelarut organik *Soluble in water and insoluble in organic solvents* Sebab: Molekul air mengatasi daya tarikan elektrostatik antara ion supaya ion bebas bergerak tetapi pelarut organik tidak dapat mengatasi daya tarikan tersebut *Reason: Water molecules overcome the electrostatic attraction force between ions so that ions move freely but organic solvents cannot overcome the attraction force.*	(f) Tidak larut di dalam air, larut di dalam pelarut organik. *Insoluble in water and but soluble in organic solvents.* Sebab: Molekul neutral tidak membawa sebarang cas. *Reason: Neutral molecule does not carry any charges*
Takat lebur dan takat didih ***Melting point and boiling point***	
(g) Tinggi *High* (i) Sebab: Daya tarikan elektrostatik yang kuat antara ion. Banyak haba diperlukan untuk mengatasi daya ini. *Reason: Strong electrostatic attraction force between ions. More heat is needed to overcome the force.*	(h) Rendah *Low* (j) Sebab: Daya tarikan van der Waals yang lemah antara molekul. Sedikit haba diperlukan untuk mengatasi daya ini. *Reason: Weak van der Waals attraction force between molecules. Less heat is needed to overcome the force.*
Contoh ***Examples***	
(k) Natrium klorida, magnesium oksida *Sodium chloride, magnesium oxide*	(l) 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*	**Keadaan mentol** *Condition of bulb*
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*	**Keterlarutan di dalam air** *Solubility in water*	**Keterlarutan di dalam sikloheksana** *Solubility in cyclohexane*
Magnesium klorida *Magnesium chloride*	Larut *Soluble*	Tidak larut *Insoluble*
Naftalena *Napthalene*	Tidak larut *Insoluble*	Larut *Soluble*

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) Suhu pemanasan / *Heating temperature*

Keputusan / *Results*:

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

Perbincangan / *Discussion*:

Sifat *Properties*	**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 yang bebas bergerak / Mempunyai molekul neutral *No free moving ions / I have neutral molecules*
Keterlarutan ***Solubility***	Magnesium klorida *Magnesium chloride*	Terdiri daripada ion *Consists of ions*
	Naftalena *Napthalene*	*Terdiri daripada molekul* *Consists of molecules*
Takat lebur dan takat didih ***Melting point and boiling point***	Magnesium klorida *Magnesium chloride*	Daya tarikan elektrostatik yang kuat antara ion. Maka, lebih banyak tenaga haba diperlukan untuk mengatasi daya tarikan 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, kurang tenaga haba diperlukan untuk mengatasi daya tarikan itu. *Weak van der Waals attraction force between molecules. Thus, less theat is needed to overcome the attraction force.*

Kesimpulan / *Conclusion:*

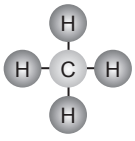
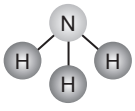
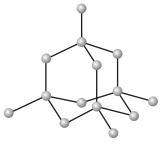
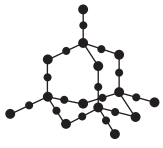
1. ion / *ionic*

2. kovalen / *covalent*

Struktur Sebatian Kovalen
Structure of Covalent Compounds

1.

	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*
Keadaan fizik *Physical state*	Pepejal, cecair atau gas *Solid, liquid or gas*	Biasanya pepejal *Usually solid*

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 kuat dalam molekul sahaja. *Only strong covalent bonds in the molecules*
Takat lebur dan takat didih *Melting point and boiling point*	Takat lebur dan takat didih adalah rendah kerana sedikit haba diperlukan untuk mengatasi daya tarikan van der Waals yang lemah. *Melting point and boiling point are low because only little heat is required to overcome the weak van der Waals attraction forces.*	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.*
Contoh *Examples*	• Oksigen *Oxygen*  • Metana *Methana*  • Ammonia *Ammonia* 	• Berlian *Diamond*  • Silikon dioksida *Silicon dioxide* 

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 batteries.

(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.** B	**5.** A
6. B	**7.** A	**8.** B	**9.** C	**10.** D

Soalan Subjektif

Bahagian B

1. (a) (i) Ikatan kovalen antara dua atom yang mana pasangan elektron yang dikongsi berasal daripada satu atom sahaja.
Covalent bond between two atoms where the electron pair that is shared comes from one atom only.

(ii) Persamaan / *Similarity*:
Perkongsian elektron antara atom-atom unsur bukan logam.
Electron sharing between atoms of non-metal elements.

Perbezaan / *Difference:*
Elektron dalam ikatan kovalen disumbangkan oleh kedua-dua atom manakala dalam ikatan datif, elektron disumbangkan oleh satu atom sahaja.
Electrons in a covalent bond are contributed by both atoms while in a dative bond, electrons are contributed by one atom only.

(b) (i) Hidrogen bromida: Ikatan kovalen
Hydrogen bromide: Covalent bond
Natrium bromida: Ikatan ion
Sodium bromide: Ionic bond

(ii) Takat lebur/ takat didih yang tinggi
High melting point/ boiling point

Bahagian B

2. (a) (i) Ikatan kovalen / *Covalent bond*
Susunan elektron atom klorin: 2.8.7
Mempunyai 7 elektron valens
Setiap atom Cl menyumbang 1 elektron untuk dikongsi.
Mencapai susunan elektron oktet yang stabil, 2.8.8
Electron arrangement of chlorine atom: 2.8.7
Has seven valence electrons
Each chlorine atom contributes one electron to be shared
Achieves the stable octet electron arrangement, 2.8.8

(ii) Asid hidroklorik / *Hydrochloric acid*
Berasid / *Acidic*
Asid hipoklorus / *Hypochlorous acid*
Melunturkan / *Bleaching*

(b) (i) Bahan *P*: ikatan ion
Natrium klorida, NaCl
Bahan *Q*: ikatan kovalen
Naftalena, $C_{10}H_8$
Substance P: Ionic bond
Sodium chloride, NaCl
Substance Q: Covalent bond
Naphthalene, $C_{10}H_8$

(ii) Bahan *P* mempunyai takat lebur yang tinggi.
Bahan *Q* mempunyai takat lebur yang rendah.
Bahan *P* memerlukan haba yang banyak untuk mengatasi daya tarikan elektrostatik yang kuat antara ion.
Bahan *Q* memerlukan haba yang sedikit untuk mengatasi daya tarikan van der Waals yang lemah antara molekul.
Substance P has a high melting point.
Substance Q has a low melting point.
Substance P needs a lot of heat to overcome the strong electrostatic attraction force between the ions.
Substance Q needs little heat to overcome the weak van der Waals attraction force between the molecules.

Praktis Ekstra SPM 5

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

Jawapan

Bab 6

Bab 6

Asid , Bes dan Garam
Acid, Base and Salt

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

Apakah Asid, Bes dan Alkali?
What are Acid, Base and Alkali?

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

CONTOH 1

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

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) $MgO(ak) + 2HCl(ak) \longrightarrow MgCl_2(ak) + H_2O(ce)$
$MgO(aq) + 2HCl(aq) \dashrightarrow MgCl_2(aq) + H_2O(l)$
$CaCOH_2(ak) + 2HCl(ak) \longrightarrow CaCl_2(ak) + H_2O(ce)$
$Ca(OH)_2(aq) + 2HCl(aq) \dashrightarrow CaCl_2(aq) + H_2O(l)$
(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 ions, OH^-*

CONTOH 2

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

Peranan Air untuk Menunjukkan Keasidan dan Kealkalian
Role of Water to Show Acidity and Alkalinity

1. mengion, hidrogen, H^+, hidroksonium, H_3O^+ / *ionise, hydrogen, H^+, hydroxonium, H_3O^+*
2. 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 *Solid oxalic acid*	Tiada perubahan *No changes*	Tiada ion hidrogen hadir *No hydrogen ion is present*
Asid oksalik + air *Oxalic acid + water*	Biru kepada merah *Blue to red*	Ion hidrogen hadir *Hydrogen ions are present*

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

Keputusan / *Conclusion*:
air, hidrogen / *water, hydrogen*

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*	Tiada ion hidroksida hadir *No hydroxide ion is present*
Natrium hidroksida + air *Sodium hydroxide + water*	Merah kepada biru *Red to blue*	Ion hidroksida hadir *Hydroxide ions are present*

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

Keputusan / *Conclusion*:
air, hidroksida / *water, hydrogen*

6.2 Nilai pH
pH Values

1. hidrogen / *hydrogen*
2. keasidan, kealkalian
Acidity, alkalinity

CONTOH 3

1. pH = -log [H^+]
pH = -log 0.02
pH = 1.7

1. pOH = -log [OH^-]
= -log 0.1
= 1
pH = 14 -1
pH = 13

Eksperimen 6.3

Hipotesis / *Hypothesis*:
tinggi, rendah / *higher, lower*

Pemboleh ubah / *Variables*:
(a) Kepekatan ion H^+ / *Concentration of H^+ ions*
(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 / *Discussion:*
1. hidrogen / *hydrogen*
2. berkurang / *decreases*

Keputusan / *Conclusion:*
Kepekatan, tinggi, rendah, / *concentration, higher, lower*

Eksperimen 6.4

Hipotesis / *Hypothesis*:
tinggi, tinggi / *higher, higher*

Pemboleh ubah / *Variables*:
(a) Kepekatan ion OH^- / *Concentration of OH^- ions*
(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 / *Discussion:*
1. hidroksida / *hydroxide*
2. bertambah / *increases*

Keputusan / *Conclusion*:
Kepekatan, tinggi, tinggi, / *concentration, higher, higher*

6.3 Kekuatan Asid dan Alkali
Strength of Acids and Alkalis

1. lengkap, tinggi / *completely, high*
2. tinggi, hidrogen, rendah / *high, hydrogen, low*
3. separa, rendah / *partially, low*
4. rendah, hidrogen, tinggi / *low, hydrogen, high*
5. lengkap, tinggi / *completely, high*
6. tinggi, hidroksida, tinggi / *high, hydroxide, high*
7. separa, rendah / *partially, low*
8. rendah, hidroksida, rendah / *low, hydroxide, low*

6.4 Kekuatan Asid dan Alkali
Strength of Acids and Alkalis

Sifat Kimia Asid
Chemical Properties of Acid

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 forms 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*:

9.	**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*	$CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$

Sifat Kimia Alkali
Chemical Properties of Alkali

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 terlarutkan, 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 1

1. Sifat fizik: Rasa masam // pH kurang dari 7 // menukar kertas litmus biru ke merah
Sifat kimia: Asid bertindak balas dengan alkali menghasilkan garam dan air //
Asid bertindak balas dengan logam reaktif menghasilkan garam dan gas hidrogen
Physical property: Sour taste // pH less than 7 // change blue litmus paper to red
Chemical property: Acid reacts with alkali to produce salt and water //
Acid reacts with reactive metal to produce salt and hydrogen gas

2.

Bahan ***Substance***	**Uji dengan kertas litmus** ***Test with litmus paper***	
	Kertas litmus merah ***Red litmus paper***	**Kertas litmus biru** ***Blue litmus paper***
(a) Asid etanoik kering *Dry ethanoic acid*	Kekal merah *Remains red*	Kekal biru *Remains blue*
(b) Asid etanoik *Ethanoic acid*	Kekal merah *Remains red*	Merah *Red*
(c) Pepejal natrium hidroksida *Solid sodium hydroxide*	Kekal merah *Remains red*	Kekal biru *Remains blue*
(d) Larutan natrium hidroksida *Sodium hydroxide solution*	Biru *Blue*	Kekal biru *Remains blue*
(e) Asid etanoik dalam propanon *Ethanoic acid in propanone*	Kekal merah *Remains red*	Kekal biru *Remains blue*
(f) Ammonia akueus *Aqueous ammonia*	Biru *Blue*	Kekal biru *Remains blue*
(g) Asid sulfurik *Sulphuric acid*	Kekal merah *Remains red*	Merah *Red*

3.

Bahan *Substance*	Persamaan kimia *Chemical equation*
(a) Asid hidroklorik dengan magnesium *Hydrochloric acid with magnesium*	$2HCl + Mg \rightarrow MgCl_2 + H_2$
(b) Larutan kalium hidroksida dengan asid sulfurik *Potassium hydroxide solution with sulphuric acid*	$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$
(c) Kalsium oksida dengan asid nitrik *Calcium oxide with nitric acid*	$CaO + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O$
(d) Zink karbonat dengan asid nitrik *Zinc carbonate with nitric acid*	$ZnCO_3 + HNO_3 \rightarrow Zn(NO_3)_2 + H_2O + CO_2$
(e) Asid hidroklorik dengan ammonia akueus *Hydrochloric acid with aqueous ammonia*	$HCl + NH_3 \rightarrow NH_4Cl$

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} / *moles, 1 dm^3, mol dm^{-3}*

3. $NaOH = \dfrac{18}{23 + 16 + 1}$

$= 0.45$ mol

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

$0.45 = \dfrac{M \times 750}{1000}$

$M = 0.6$ mol dm^{-3}

Tugasan 2

1. (a) $n = \dfrac{0.2 \times 250}{1000}$
$= 0.05$ mol

(b) $0.4 = \dfrac{M \times 2000}{1000}$
$M = 0.2$ mol dm^{-3}

2. $4K + O_2 \rightarrow 2K_2O$

$n\ K = \dfrac{7.8}{39} = 0.2$ mol

$4K : 2K_2O$

$0.2 : 0.1$

$K_2O + H_2O \rightarrow 2KOH$

$K_2O : 2KOH$

$0.1 : 0.2$

$M = \dfrac{0.4 \times 1000}{500}$

$M = 0.8$ mol dm^{-3}

6.6 Larutan Piawai
Standard Solution

1. kepekatannya / *concentration*

Penyediaan Larutan Piawai daripada Bahan Pepejal
Preparation of Standard Solution from Solid Substance

Aktiviti 6.3

Prosedur / *Procedure*:

1. $n = \frac{1.0 \times 250}{1000} = 0.25$ mol

$m = 0.25 \times 106 = 26.5$ g

Perbincangan / *Discussion*:

(a) Untuk memastikan semua natrium karbonat terlarut
To make sure that all tof he sodium carbonate is dissolved

(b) Untuk menghalang penyejatan larutan natrium karbonat
To prevent the evaporation of sodium carbonate solution

Aktiviti 6.4

Prosedur / *Procedure*:

1. $M_1V_1 = M_2V_2$

$V_1 = \frac{0.2 \times 100}{1.0} = 20$ cm^3

Perbincangan / *Discussion*:

1. 20 cm^3

2. Bikar tidak mempunyai tanda senggatan dan penyejatan/ percikan mudah berlaku.
A beaker has no calibration mark and evaporation / splashing easily occurs.

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

$M = \frac{0.2 \times 1000}{500} = 1.0$ mol dm^{-3}

6.7 Peneutralan
Neutralisation

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

Persamaan kimia *Chemical equation*	Persamaan ion *Ionic 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*

Kaedah Pentitratan / *Titration Method:*

2. (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*

Aktiviti 6.5

Keputusan / *Results:*

Titratan *Titration*	Kasar *Rough*	1	2	3
Bacaan akhir (cm^3) *Final reading (cm^3)*	27.00	25.50	24.50	24.50
Bacaan awal (cm^3) *Initial reading (cm^3)*	0.00	0.00	0.00	0.00
Isi padu HCl (cm^3) *Volume of HCl (cm^3)*	27.00	25.50	24.50	24.50

Mentafsir data / *Interpreting data*:

1. (a) 24.83 cm^3

(b) $KOH + HCl \rightarrow KCl + H_2O$

$H^+ + OH^- \rightarrow H_2O$

(c) $n = \frac{1.0 \times 24.83}{500}$

$= 0.0248\ cm^3$

(d) HCl : KOH

1 : 1

0.0243 : 0.0243

$M\ KOH = \frac{0.0243 \times 1000}{25}$

$= 0.99\ mol\ dm^{-3}$

Perbincangan / *Discussion*:

1. Merah jambu kepada tidak berwarna / *Pink to colourless*

2. Untuk memudahkan melihat perubahan warna apabila takat akhir dicapai

To make it easier to see the colour change when the end point is reached

3. (a) $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$

$M_aV_a = a$

$M_bV_b = b$

$V_a = \frac{1 \times 1.0 \times 2.5}{2 \times 0.5}$

$= 25\ cm^3$

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

(ii) Purata isi padu H_2SO_4 / *Average volume of* H_2SO_4 $= \frac{9.90 + 10.00 + 10.10}{3}$

$= 10.00\ cm^3$

(iii) $H_2SO_4 : 2KOH$

1 mol : 2 mol

$n = \frac{1.0 \times 10}{1000}$

$= 0.01\ mol : 0.02\ mol$

$M\ KOH = \frac{2 \times 1.0 \times 10}{1 \times 25}$

$= 0.80\ mol\ dm^{-3}$

6.8 Garam, Hablur dan Kegunaan dalam Kehidupan Harian
Salts, Crystals and Uses in Daily Life

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

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

Ciri-ciri Fizikal Hablur Garam
Physical Characteristics of Salt Crystals

Hablur / ***Crystal***

1. Bentuk geometri ___tetap___.

___*Fixed*___ *geometrical shapes.*

2. Permukaan ___rata___, sisi lurus dan sudut ___tajam___.

___*Flat*___ *surfaces, straight edges and* ___*sharp*___ *angles.*

3. Hablur yang sama mempunyai ___bentuk geometri___ yang sama tetapi ___saiz___ berbeza.

Same crystals have the same ___*geometrical shape*___ *but different* ___*sizes*___.

4. ___Sudut___ tetap antara dua permukaan.

Fixed ___*angles*___ *between two surfaces.*

Contoh Garam dan Kegunaannya
Examples of Salts and Their Uses

Kegunaan *Uses*	**Contoh dan nama garam** *Examples and names of salt*	
Pertanian *Agriculture*	(a) Sebagai baja: Ammonium nitrat *As fertilisers:* *Ammonium nitrate*	(b) Sebagai racun serangga: Ferum(II) sulfat *As pesticides:* *Iron(II) sulphate*
Perubatan *Medicine*	(c) Sebagai plaster: Kalsium sulfat *As plaster:* *Calcium sulphate*	(d) Sebagai ubat antiseptik: Kalium manganate(VII) *As antiseptic:* *Potassium manganate(VII)*
Penyediaan makanan *Food preparation*	(e) Sebagai perisa: Natrium klorida *As flavouring:* *Sodium chloride*	(f) Penaik adunan : Natrium bikarbonat *As raising dough:* *Sodium bicarbonate*
Pengawet *Preservation*	(g) Pengawet sos: Natrium benzoat *Sauce preservative:* *Sodium benzoate*	(h) Pengawet daging proses: Natrium nitrat *Processed meat preservative:* *Sodium nitrate*

Tugasan 3

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)	$MgO + H_2SO_4 \rightarrow$ ___$MgSO_4$___ $+ H_2O$
(b)	$Zn +$ ___$2HCl$___ $\rightarrow ZnCl_2 + H_2$
(c)	$MgCO_3 + 2HNO_3 \rightarrow$ ___$Mg(NO_3)_2$___ $+ H_2O +$ ___CO_2___
(d)	___$Pb(NO_3)_2$___ $+$ ___$2NaCl$___ $\rightarrow PbCl_2 + 2NaNO_3$
(e)	$HCl + NaOH \rightarrow$ ___$NaCl$___ $+$ ___H_2O___

6.9 Penyediaan Garam
Preparation of Salts

Keterlarutan Garam di dalam Air
Solubility of Salts in Water

1. terlarutkan / *Soluble*
2. tak terlarutkan / *Insoluble*
3.

Garam *Salt*	**Garam terlarutkan** *Soluble salt*	**Garam tak terlarutkan** *Insoluble salt*
(i) Garam nitrat *Nitrate salts*	Semua garam nitrat *All nitrate salts*	–
(ii) Garam klorida *Chloride salts*	Semua garam klorida *All chloride salts*	Plumbum(II) klorida / *Lead(II) chloride* Argentum klorida / *Silver chloride* Merkuri(II) klorida / *Mercury(II) chloride*
(iii) Garam sulfat *Sulphate salts*	Semua garam sulfat *All sulphate salts*	Plumbum(II) sulfat / *Lead(II) sulphate* Kalsium sulfat / *Calcium sulphate* Barium sulfat / *Barium sulphate*
(iv) Garam karbonat *Carbonate salts*	Natrium karbonat / *Sodium carbonate* Kalium karbonat / *Potassium carbonate* Ammonium karbonat / *Ammonium carbonate*	Semua garam karbonat *All carbonate salts*
(v) Garam natrium, kalium dan ammonium *Sodium, potassium and ammonium salts*	Semua garam natrium, kalium dan ammonium larut di dalam air *All sodium, potassium and ammonium salts dissolve in water*	–

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 / *Discussion*:

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 / *Conclusion*:

larut, tidak larut / *dissolve, do not*

Penyediaan Garam Terlarutkan selain Garam Ammonium, Natrium dan Kalium
Preparation of Soluble Salts Other Than Ammonium, Sodium and Potassium Salts

Aktiviti 6.6

Perbincangan / *Discussion*:

(a) - Warna penunjuk fenolftalein bertukar daripada merah jambu kepada tidak berwarna.
The colour of phenolphthalein indicator changes from pink to colourless.
- Larutan garam tak berwarna terhasil. // Garam berwarna putih terbentuk.
A colourless salt solution is produced. // White salt is formed.

(b) Untuk memastikan larutan garam tidak mengandungi bendasing
To make sure that the salt solution does not contain impurities

(c) $HCl + KOH \rightarrow KCl + H_2O$

(d) Ammonium nitrat // Natrium sulfat
Ammonium nitrate // Sodium sulphate

Penyediaan Garam Terlarutkan melalui Tindak Balas antara Asid dan Oksida Logam
Preparation of Soluble Salts by a Reaction between Acid and Metal Oxide

Aktiviti 6.7

Perbincangan / *Discussion*:

(a) - Serbuk kuprum(II) oksida larut.
Copper(II) oxide powder dissolved.
- Larutan biru terhasil. // Pepejal biru terbentuk.
A blue solution is produced. // Blue solid is formed.

(b) Untuk memastikan semua ion hidrogen bertindak balas dengan lengkap
To make sure that all of the hydrogen ions have reacted completely

(c) $CuO + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O$
$CuO + 2H^+ \rightarrow Cu^{2+} + H_2O$

Pembinaan Persamaan Ion melalui Kaedah Perubahan Berterusan
Constructing an Ionic Equation by Continuous Variation Method

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 / *Results*:

Tabung uji *Test tube*	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
Ketinggian mendakan (cm) *Height of precipitate (cm)*	0.6	1.2	1.8	2.4	3.0	3.0	3.0

Perbincangan / *Discussion*:

1.

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

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

3. 1, 2, 1

Kesimpulan / *Conclusion*:

1. perubahan berterusan / *continuous variation*

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

6.10 Penyediaan Garam
Preparation of Salts

1. gas, asid / *gas, acid*

Ujian Gas
Gas Test

1.

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 semula. *Wooden splinter rekindles.*
(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 is 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 of 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 lembap menjadi merah dan kemudian putih. *Moist red litmus paper turns blue and then white.*
(vi) Hidrogen klorida, HCl *Hydrogen chloride, HCl* • 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 is 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.*

2.

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*
Ferum(III) oksida / *Iron(III) oxide*	Perang / *Brown*	Perang / *Brown*
Magnesium oksida / *Magnesium oxide*	Putih / *White*	Putih / *White*

Kesan Haba terhadap Garam
The Effect of Heat on Salts

(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*	$2Cu(NO_3)_2 \longrightarrow \underline{2CuO} + \underline{4NO_2} + O_2$
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 / *Results*:

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(II) 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 / *Results*:

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*

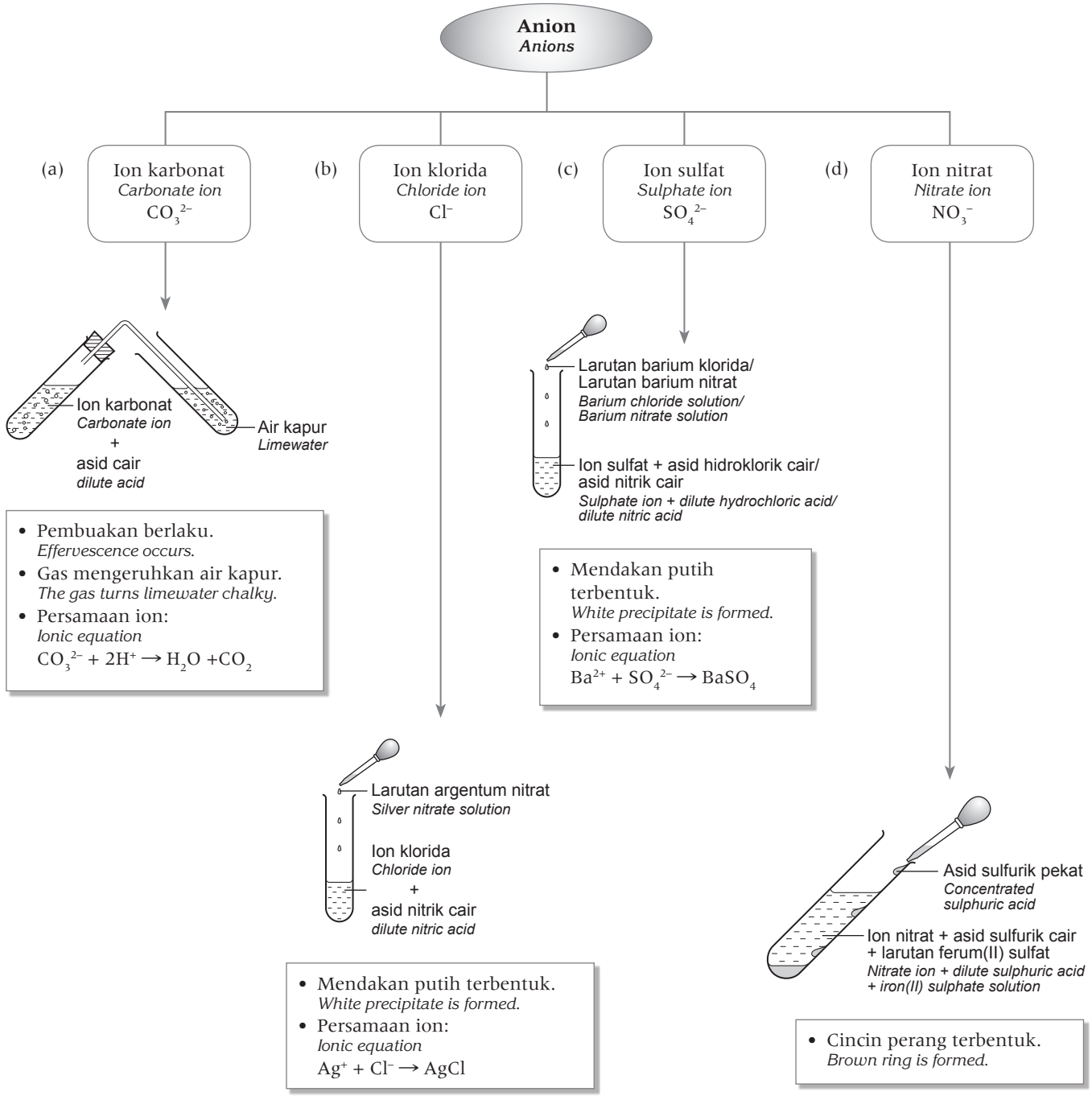
Kation ***Cation***	**Karbonat (CO_3^{2-})** ***Carbonate (CO_3^{2-})***	**Nitrat (NO_3^-)** ***Nitrate (NO_3^-)***
Na^+	Tidak terurai / *Does not decompose*	$2NaNO_3 \rightarrow 2NaNO_2 + O_2$
K^+	Tidak terurai / *Does not decompose*	$2KNO_3 \rightarrow 2KNO_2 + O_2$
Mg^{2+}	$MgCO_3 \rightarrow MgO + CO_2$	$2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$
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*
$NH_4Cl \rightleftharpoons NH_3 + HCl$
(a) sengit */ pungent*
(b) merah, biru */ red, blue*

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

A Ujian bagi anion
Anion tests

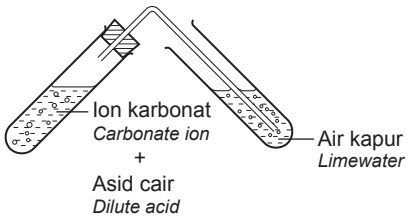
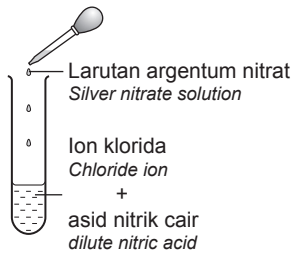


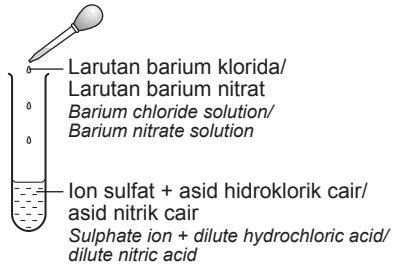
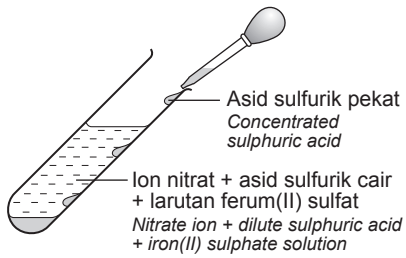
Eksperimen 6.9

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:* $CO_3^{2-} + 2H^+ \rightarrow \underline{CO_2 + H_2O}$	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 *Effervescence 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:* $Ag^+ + Cl^- \rightarrow \underline{AgCl}$	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 terbentuk *White precipitate is formed*	Argentum klorida *Silver chloride* Ion klorida hadir. *Chloride ion is present.*

(c) Ion sulfat, SO_4^{2-} *Sulphate ion, SO_4^{2-}*  Persamaan ion / *Ionic equation:* $Ba^{2+} + SO_4^{2-} \rightarrow \underline{BaSO_4}$	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 <u>putih</u> terbentuk *<u>White</u> precipitate is formed*	<u>Barium sulfat</u> *<u>Barium sulphate</u>* Ion <u>sulfat</u> wujud. *<u>Sulphate</u> ion is present.*
(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.*	<u>Cincin perang</u> terbentuk. *Brown <u>ring</u> is formed.*	Ion <u>nitrat</u>hadir. *<u>Nitrate</u> ion is present.*

Perbincangan / *Discussion*:

1. negatif / *negative*

2. (a) asid / *asid*

Keputusan / *Result*:

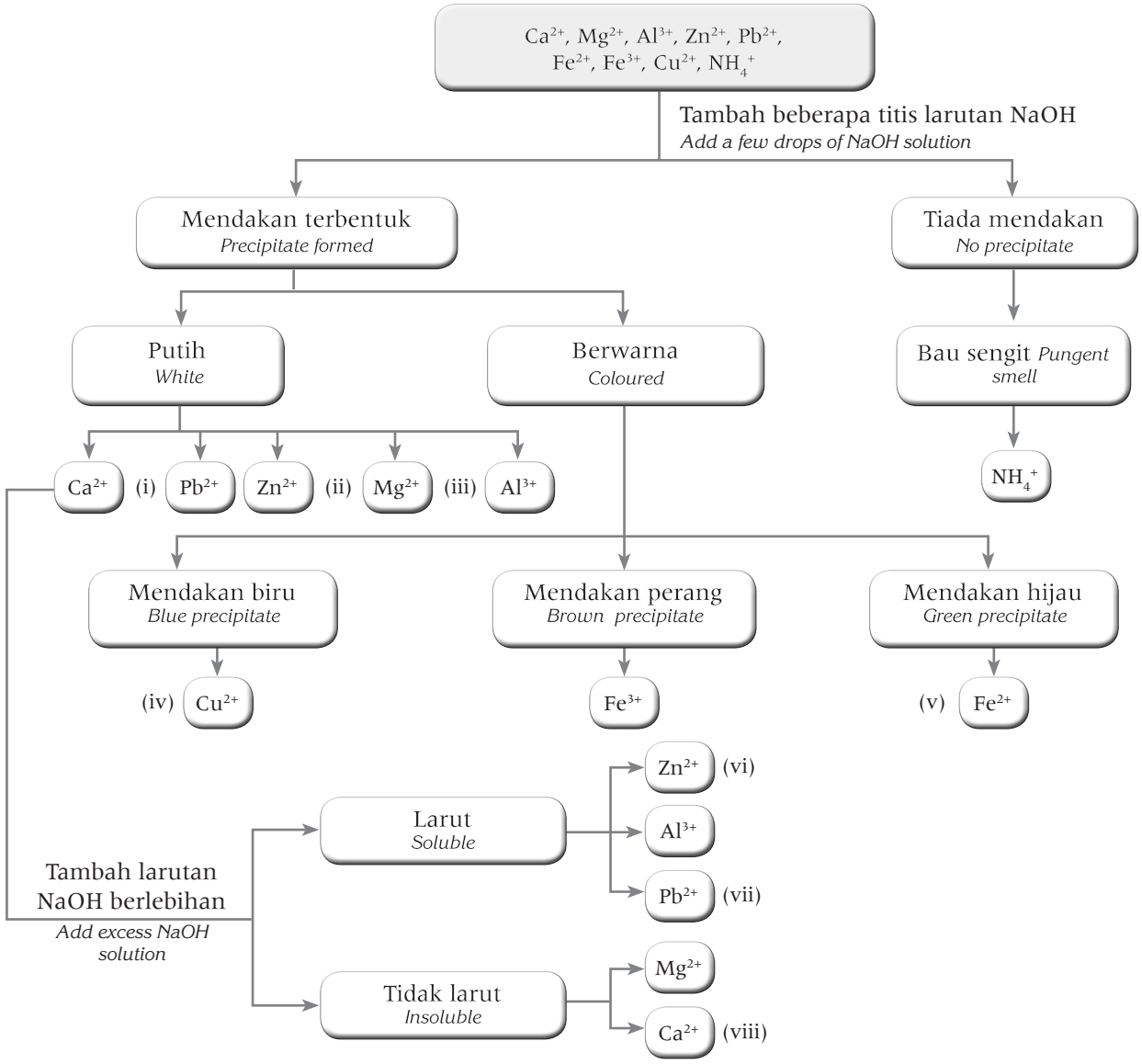
pemerhatian / *observations*

B Ujian kation

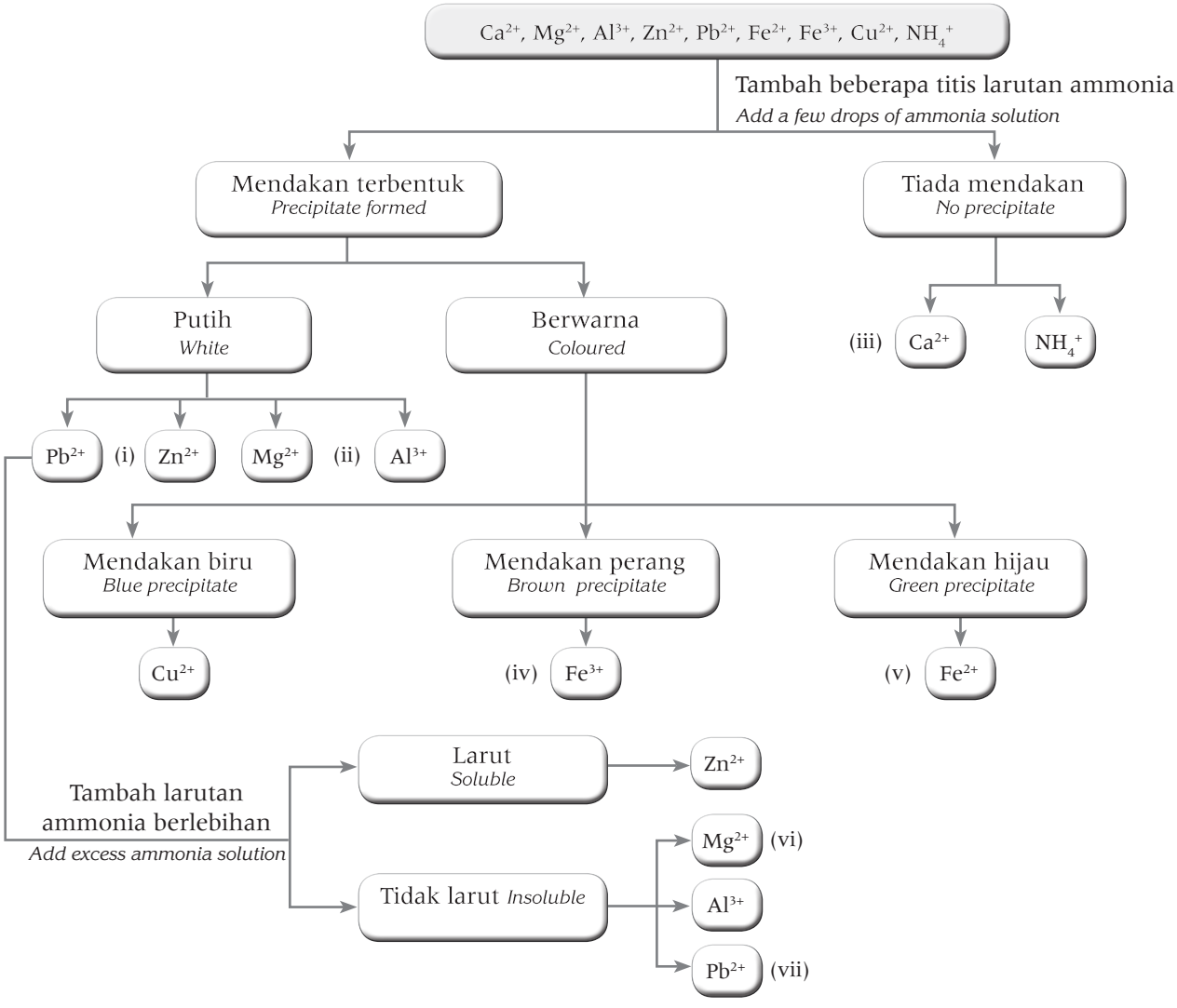
Cation tests

natrium hidroksida, ammonia / *sodium hydroxide, ammonia*

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



(b) Larutan ammonia, NH_3 / *Ammonia solution, NH_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 / *Results*:

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*

Kesimpulan / *Conclusion*:
pemerhatian / *observations*

Eksperimen 6.11

Pemboleh ubah / *Variables*:

(a) Kation hadir / *Cations present*
(c) Isi padu larutan garam akueus / *Volume of aqueous salt solutions*

Prosedur dan keputusan / *Procedure and results:*

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 of potassium iodide solution is added followed by 3 cm^3 of 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 is present*
(b) 2 cm^3 larutan kalium heksasianoferat(III) ditambahkan *2 cm^3 of potassium hexacyanoferrate(III) solution is added*	Mendakan biru tua *Dark blue precipitate*	Ion Fe^{2+} hadir *Fe^{2+} ion is present*
(c) 2 cm^3 larutan kalium heksasianoferat(II) ditambahkan *2 cm^3 of potassium hexacyanoferrate(II) solution is added*	Mendakan biru tua *Dark blue precipitate*	Ion Fe^{3+} hadir *Fe^{3+} ion is present*
(d) 2 cm^3 larutan kalium tiosianat ditambahkan *2 cm^3 of potassium thiocyanate solution is added*	Larutan merah darah *Blood red solution*	Ion Fe^{3+} hadir *Fe^{2+} ion is present*
(e) 2 cm^3 reagen Nessler ditambahkan *2 cm^3 of Nessler reagent is added*	Mendakan perang *Brown precipitate*	Ion NH_4^+ hadir *NH_4^+ ion is present*

Perbincangan / ***Discussion:***

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

Kesimpulan / ***Conclusion:***

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 Subjektif

Bahagian A

1. (a) Alkali ialah bahan kimia yang mengion di dalam air untuk menghasilkan ion hidroksida, OH^-.
Alkali is a chemical substance that ionises in water to produce hydroxide ions, OH^-.

(b) Asid *P*: Asid sulfurik / *Acid P: Sulphuric acid*
Alkali *Q*: Kalium hidroksida
Alkali Q: Potassium hydroxide

(c) Asid *P* ialah asid kuat. Nilai ph 1 menunjukkan bahawa asid itu mempunyai kepekatan ion hidrogen yang tinggi.
Acid P is a strong acid. The pH value of 1 shows that the acid has a high concentration of hydrogen ions.

(d) Digunakan di dalam akumulator asid plumbum (bateri kereta)
Used in lead-acid accumulator (car battery)

2. (a) Hijau / Green

(b) (i) Serbuk hijau menjadi hitam
Green powder turns black
(ii) Air kapur menjadi keruh / *Limewater turns cloudy*

(c) Kuprum(II) oksida dan gas karbon dioksida
Copper(II) oxide and carbon dioxide gas

(d) Pastikan salur penghantar dicelup ke dalam air kapur.
Make sure that the delivery tube is immersed in the limewater.

Bahagian B

3. (a) Garam ialah sebatian ion yang terbentuk apabila ion hidrogen daripada asid digantikan dengan ion logam atau ion ammonium.
Salt is an ionic compound formed when the hydrogen ion from an acid is replaced by the metal ion or ammonium ion.
Garam terlarutkan / *Soluble salts*: $Zn(NO_3)_2$, $CuSO_4$
Garam tak terlarutkan / *Insoluble salts*:
$MgCO_3$, AgCl, PbI_2

(b) Garam terlarutkan / *Soluble salt*:
(i) Asid + alkali ---> air + garam (peneutralan)
Acid + alkali ---> water + salt (neutralisation)
(ii) Asid + oksida logam ---> air + garam (peneutralan)
Acid + metal oxide ---> water + salt (neutralisation)
(iii) Asid + logam reaktif ---> garam + gas hidrogen (penyesaran)
Acid + reactive metal produces salt + hydrogen gas (displacement)
(iv) Asid + karbonat logam ---> garam + air + gas karbon dioksida
Acid + metal carbonate ---> salt + water + carbon dioxide gas

Garam tak terlarutkan: Penguraian ganda dua
Insoluble salt: Double decomposition

(c) Kuning kepada jingga / *Yellow to orange*

$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$

$\frac{M_a V_a}{M_b V_b} = \frac{a}{b}$

$V_b = \frac{2 \times 0.5 \times 50}{1 \times 0.5}$

$= 100\ cm^3$

(d) Natrium klorida. Sebagai perisa makanan/ pengawet
Sodium chloride. As food flavouring/ preservative
Kalsium sulfat. Sebagai plaster Paris untuk menyokong tulang yang patah
Calcium sulphate. As plaster of Paris to support broken bones

Bahagian C

4. (a) Garam K: Plumbum(II) nitrat, $Pb(NO_3)_2$
Salt K: Lead(II) nitrate, $Pb(NO_3)_2$
Pepejal S: Plumbum(II) iodida, PbI_2
Solid S: Lead(II) iodide, PbI_2
Pepejal J: Plumbum(II) oksida, PbO
Solid J: Lead(II) oxide, PbO
$2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$
PbO berwarna perang semasa panas dan kuning semasa sejuk.
PbO is brown when hot and yellow when cold.

(b) Ujian gas NO_2 / *NO_2 gas test:*
Dekatkan kertas litmus biru lembap. Kertas litmus biru bertukar menjadi merah.
Place a moist blue litmus paper. The blue litmus paper turns red.

Ujian gas O_2 / *O_2 gas test:*
Masukkan kayu uji berbara. Kayu uji menyala semula.
Insert a glowing wooden splinter. The splinter rekindles.

(c) Kalsium sulfat tidak larut di dalam air. // Plaster Paris kalis air.
Calcium sulphate is insoluble in water. // Plaster of Paris is waterproof.
Tindak balas penguraian ganda dua
Double decomposition reaction
Larutan natrium sulfat/ kalium sulfat dan larutan kalsium nitrat
Sodium sulphate/ potassium sulphate solution and calcium nitrate solution

(d) Kaedah I / *Method I:*
Peneutralan / *Neutralisation*
Warna merah jambu menjadi tidak berwarna.
Pink colour to colourless
Natrium klorida / *Sodium chloride*
Kaedah II / *Method II:*
Penguraian ganda dua / *Double decomposition*
Mendakan putih /*White precipitate*
Plumbum(II) klorida / *Lead(II) chloride*

Praktis Ekstra SPM 6

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

Jawapan

Bab 7

Bab 7

Kadar Tindak Balas
Rate of Reaction

7.1 Penentuan Kadar Tindak Balas
Determining Rate of Reaction

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

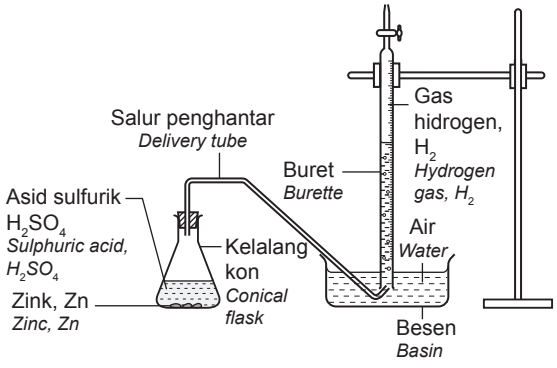
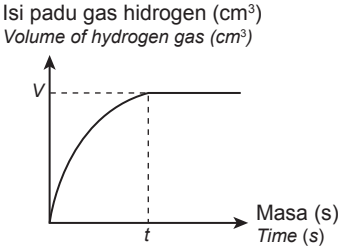
Tindak balas cepat *Fast reaction*	**Tindak balas perlahan** *Slow reaction*
Pembakaran / *Combustion*	Pengaratan / *Rusting*
Letupan / *Explosion*	Fotosintesis / *Photosynthesis*
Penyesaran / *Displacement*	Penapaian / *Fermentation*
Penguraian ganda dua / *Double decomposition*	Respirasi / *Respiration*

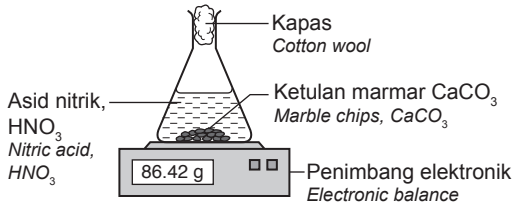
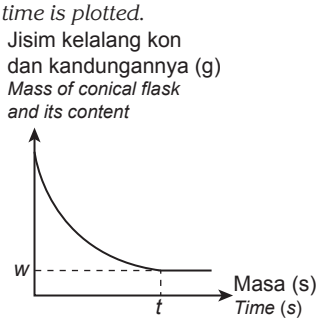
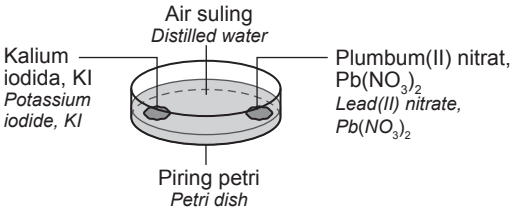
2. perubahan, masa / *change, time*

3. terus / *directly*

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

5.

Perubahan yang diperhatikan dan diukur *Observable and measureable changes*	**Eksperimen** *Experiment*	**Result** *Keputusan*
(a) Pertambahan isi padu gas *Increase in volume of gas released*	Tindak balas antara zink dengan asid sulfurik *Reaction between zink and sulphuric acid*  Persamaan kimia: *Chemical equation:* $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$	Graf isi padu hidrogen melawan masa diplotkan. *Graph of volume of hydrogen against time is plotted.*  – Isipadu gas hidrogen yang dihasilkan semakin bertambah dengan masa. *Volume of hydrogen gas produced increases with time.* – Isi padu gas hidrogen menjadi malar apabila tindak balas telah selesai pada *t* dan mencapai isi padu maksimum, *V*. *Volume of hydrogen gas is constant when the reaction has completed at t and achieved the maximum volume, V.*

(b) Pengurangan jisim badan tindak balas *Decrease in the mass of reactant*	Tindak balas antara ketulan marmar dengan asid nitrik *Reaction between marble chips with nitric acid*  Persamaan kimia: *Chemical equation:* $CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$	Graf jisim kelalang kon dan kandungannya melawan masa diplotkan. *Graph of mass of conical flask and its content against time is plotted.*  – Jisim kelalang kon dan kandungannya semakin berkurang dengan masa kerana tindak balas berlaku dan membebaskan gas ke persekitaran. – Pada *t*, tindak balas telah selesai. Maka, jisim kelalang kon dan kandungannya menjadi malar dengan jisim minimum, *w*. *At t, the reaction has completed. Thus, the mass of conical flask and its content becomes constant with the minimum mass, w.*
(c) Pembentukan mendakan *Formation of precipitate*	Tindak balas antara larutan plumbum(II) nitrat dengan larutan kalium iodida *Reaction between lead(II) nitrate solution and potassium iodide solution*  Persamaan kimia: *Chemical equation:* $Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$	Masa yang diambil untuk tindak balas selesai dan jisim mendakan direkodkan. *Time taken to complete the reaction and mass of precipitate are recorded.* **Masa yang diambil untuk tindak balas selesai (s)** *Time taken to complete the reaction (s)* | | **Jisim mendakan (g)** *Mass of precipitate (g)* | |

CONTOH 1

Kadar tindak balas purata = $\frac{10}{4 \times 60}$
Average rate of reaction
$= 0.0417 \text{ g s}^{-1}$

$n\ CaCO_3 = \frac{10}{100}$
$= 0.1 \text{ mol}$

Kadar tindak balas purata = $\frac{0.1}{4 \times 60}$
Average rate of reaction
$= 0.000417 \text{ mol s}^{-1}$

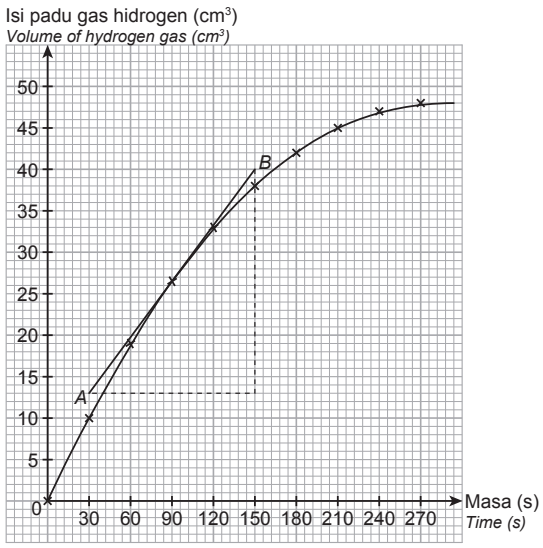
CONTOH 2

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

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

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

(b) (i)



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

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

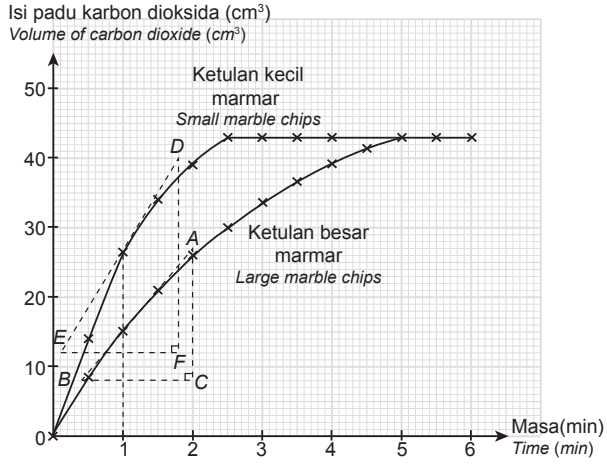
1. (a) Saiz, jumlah, pepejal / *Size, total, solid*
(b) Suhu / *Temperature*
(c) Kepekatan / *Concentration*
(d) mangkin / *catalyst*
(e) Tekanan / *Pressure*

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*

Mentafsir data / *Interpreting data*:



Ketulan marmar besar / *Large marble chips:*

$= \frac{43.0}{5.0} = 8.6 \text{ cm}^3 \text{ minit}^{-1}$ / $cm^3\ minute^{-1}$

Ketulan marmar kecil / *Small marble chips:*

$= \frac{43.0}{2.5} = 17.2 \text{ cm}^3 \text{ minit}^{-1}$ / $cm^3\ minute^{-1}$

Perbincangan / *Discussion*:

1. karbon dioksida / *carbon dioxide*

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

2. besar / *larger*

Kesimpulan / *Conclusion*:

1. kecil, tinggi / *smaller, higher*

Eksperimen 7.2

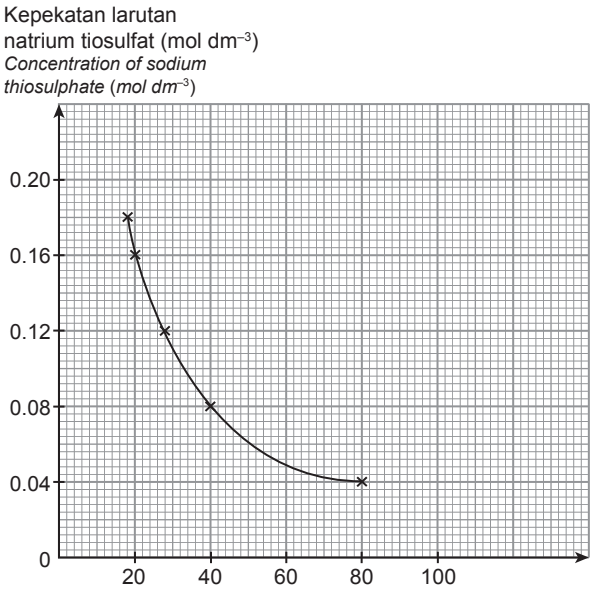
Hipotesis / *Hypothesis*:
tinggi, tinggi / *higher, higher*

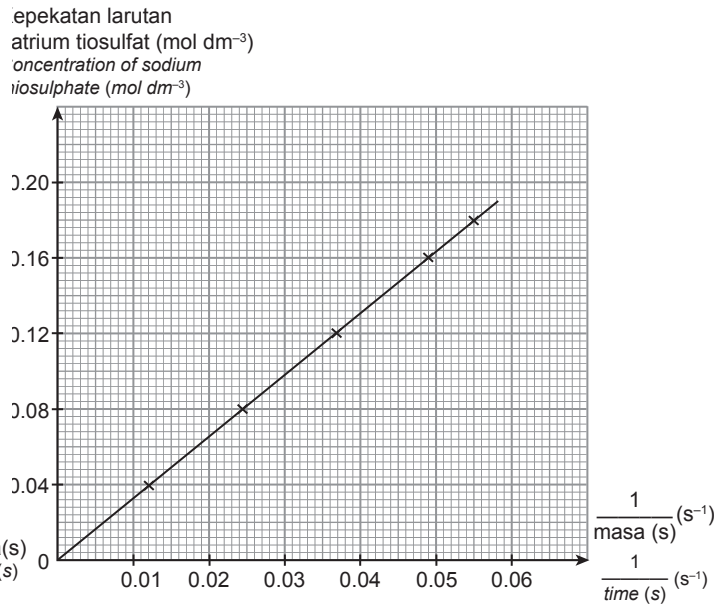
Pemboleh ubah / *Variables*:
(a) Kepekatan / *Concentration*
(c) Suhu / kepekatan dan isi padu asid sulfurik
Temperature / concentration and volume of sulphuric acid

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*

4. (a) terus / *directly*
(b) terus / *directly*

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*:

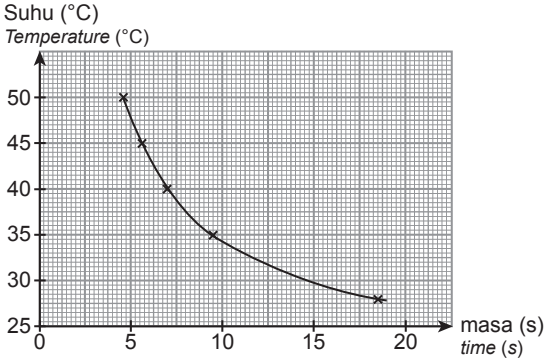
(a) Suhu / *Temperature*
(c) Kepekatan dan isi padu asid sulfurik
Concentration and volume of sulphuric acid

Keputusan / *Results*:

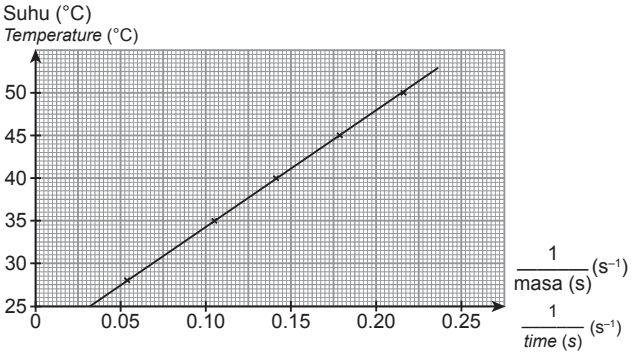
Eksperimen *Experiment*	Suhu (°C) *Temperature (°C)*	Masa, *t*(s) *Time, t(s)*	$\frac{1}{\text{masa}}$ (s^{-1}) / $\frac{1}{time}$ (s^{-1})
I	28.0	18.52	0.054
II	35.0	9.48	0.105
III	40.0	7.07	0.141
IV	45.0	5.62	0.178
V	50.0	4.63	0.216

Mantafsir data / *Interpreting data*:

1.



3.



4. kinetik, bertambah / *kinetic, increases*

Perbincangan / *Discussion*:

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

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

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

Kesimpulan / *Conclusion*:

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 (tanpa 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*
$2H_2O_2 \rightarrow O_2 + 2H_2O$

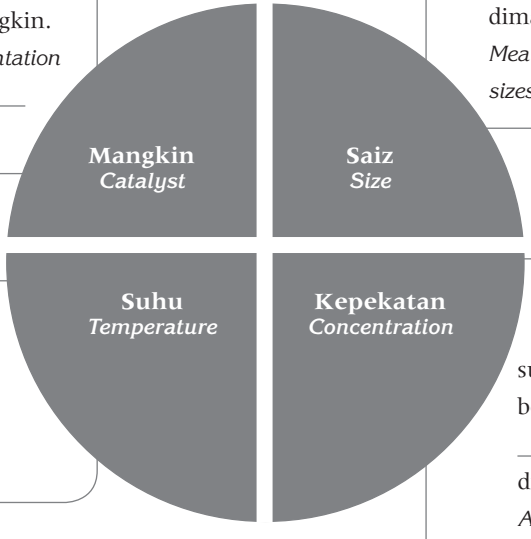
2. meningkatkan / *increases*

Kesimpulan / *Conclusion*:
meningkatkan / *increases*

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

- Penghasilan etanol melalui penapaian glukosa menggunakan enzim _____yis_____ sebagai mangkin.
  Production of ethanol through fermentation of glucose using _____yeast_____ enzyme as catalyst.

- Daging dipotong kepada saiz yang lebih _____kecil_____ supaya cepat dimasak.
  Meat is cut into _____smaller_____ sizes, so as to cook faster.



- Makanan yang dimasak pada suhu yang tinggi lebih _____cepat_____ masak.
  Food cooked at a high temperature cooks _____faster_____ .

- Hujan asid di kawasan industri yang mengandungi kepekatan sulfur dioksida yang tinggi boleh meningkatkan kadar _____kakisan_____ bahan yang diperbuat daripada besi.
  Acid rain in industrial areas that contains a high concentration of sulphur dioxide can increase the rate of _____corrosion_____ of materials made of iron.

Tugasan 1

1.

Aktiviti *Activity*	Faktor *Factor*
(a) Penyimpanan susu di dalam peti sejuk *Milk kept in the refrigerator*	Suhu *Temperature*
(b) Daging dimasak di dalam potongan kecil *Meat cooked in small sizes*	Saiz *Size*
(c) Roti diadun dengan yis *Bread kneaded with yeast*	Mangkin *Catalyst*

2. (a) Kerana kedua-dua eksperimen mempunyai kepekatan asid hidroklorik yang sama walaupun isi padu berbeza
Because both experiments have the same concentration of hydrochloric acid even though the volumes are different

(b) Kerana kedua-dua eksperimen mempunyai kepekatan asid hidroklorik yang berbeza. Eksperimen II mempunyai kepekatan yan lebih tinggi berbanding dengan eksperimen I.
Because both experiments have different concentrations of hydrochloric acid. Experiment II has a higher concentration compared to experiment I.

(c) Suhu dan kepekatan / *Temperature and concentration*

3. (a) Situasi II. Saiz daging lebih kecil. Dapat menyerap lebih banyak haba
Situation II. The size of meat is smaller. Can absorb more heat

(b) Suhu dan saiz / *Temperature and size*

7.4 Teori Perlanggaran
Collision Theory

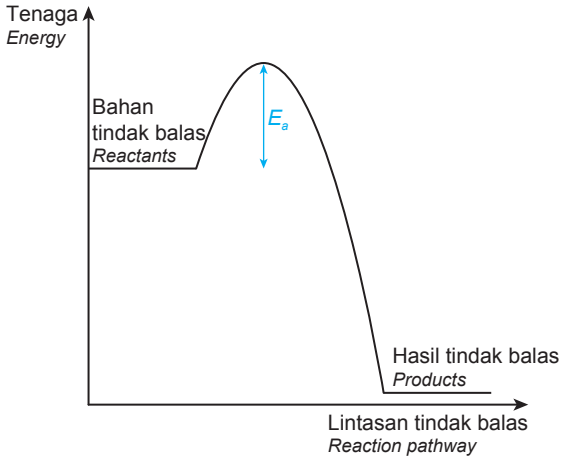
1. (a) halus, diskrit, bergerak / *moving, tiny, discrete*

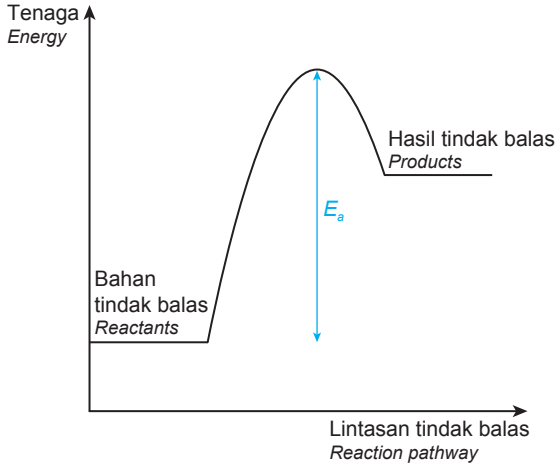
(b) (i) perlanggaran / *collision*
(ii) perlanggaran berkesan / *effective collisions*

(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*

CONTOH 3

1. (a) *M*: Zink nitrat / *Zinc nitrate*
N: Hidrogen / *Hydrogen*
(b) $Zn + 2HNO_3 \dashrightarrow Zn(NO_3)_2 + H_2$
(c) Perubahan tenaga / *Energy change* = 0 - 40 = -40 kJ
Tenaga pengaktifan / *Activation energy* = 60 kJ
(d) Tindak balas eksotermik kerana perubahan tenaga adalah negatif
Exothermic reaction because the energy change is negative

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***

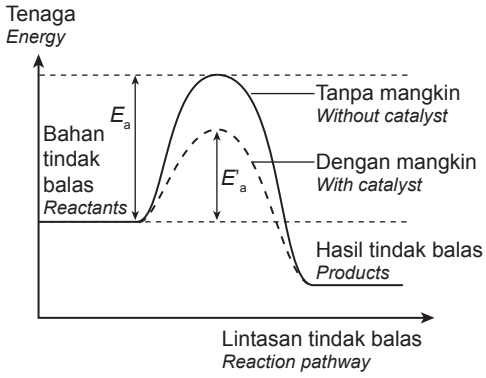
Tenaga kinetik zarah-zarah bahan tindak balas *Kinetic enegry of reactant particles*	↑
Bilangan zarah yang bertenaga untuk mengatasi tenaga pengaktifan / *Number of reactant particles that achieve the activation energy*	↑
Frekuensi perlanggaran berkesan antara zarah-zarah *Frequency of effective collisions between particles*	↑
Kadar tindak balas / *Rate of reaction*	↑

(d)

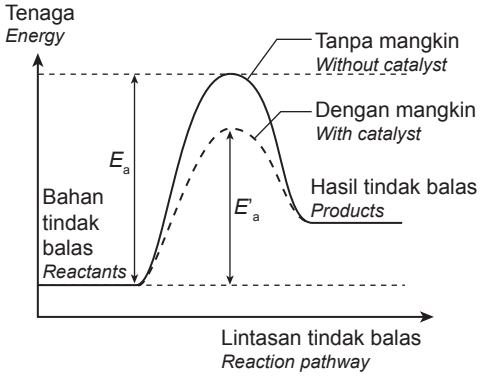
Kehadiran mangkin / ***Presence of catalyst***

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. (a)



(b)



Praktis SPM 7

Soalan Objektif

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

Soalan Subjektif

Bahagian A

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

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

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

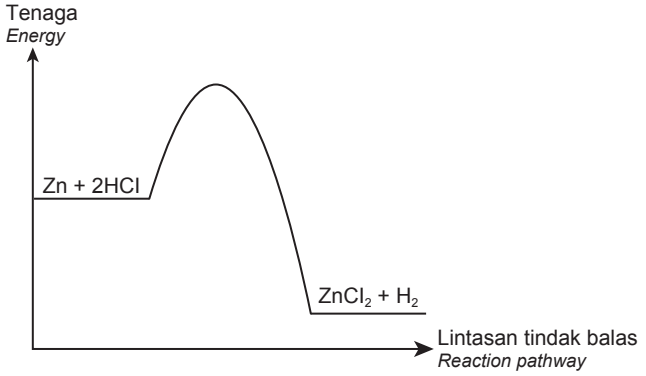
Set II: $\frac{60}{2}$
$= 30\ cm^3\ min^{-1}$

(ii) Kadar tindak balas Set II lebih tinggi daripada Set I.
The rate of reaction of Set II is higher than Set I.

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

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

(ii)

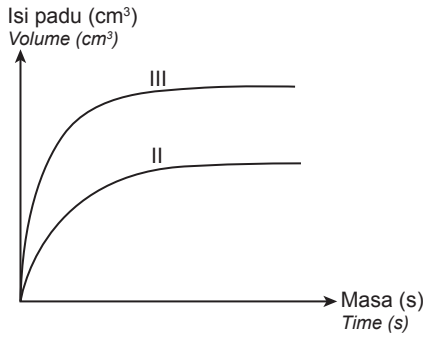


Bahagian B

2. (a) Susu yang disimpan di dalam peti sejuk kekal segar. Peti sejuk mempunyai suhu yang rendah, maka kadar pertumbuhan bakteria berkurang.
Milk kept in the refrigerator stays fresh. The refrigerator has a low temperature, thus the rate of bacterial growth decreases.
Susu yang dibiarkan pada suhu bilik menjadi masam. Suhu bilik lebih tinggi, maka kadar pertumbuhan bakteria tinggi.
Milk left at room temperature turns sour. The room temperature is higher, thus the rate of bacterial growth increases.

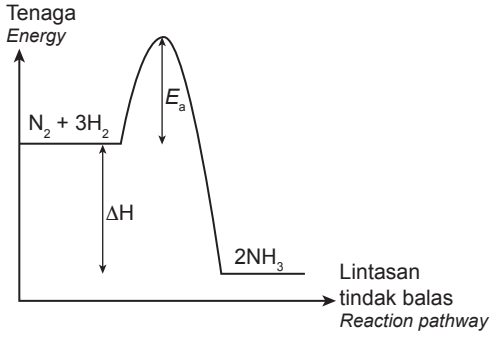
(b) (i) Kadar tindak balas purata ialah nilai purata bagi kadar tindak balas yang berlaku dalam satu tempoh masa tertentu.
Average rate of reaction is the average value for the rate of reaction that occurs in a particular time interval.
X = 30 s

(ii) $Zn + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2$
Kadar tindak balas purata / *Average rate of reaction:*
$II = \frac{50}{40} = 1.25\ cm^3\ s^{-1}$
$III = \frac{50}{24} = 2.08\ cm^3\ s^{-1}$



(c) (i) – Zarah bahan tindak balas mesti berlanggar antara satu sama untuk tindak balas berlaku.
Reactant particles must collide with one another for a reaction to occur.

– Kadar tindak balas bergantung kepada frekuensi perlanggaran berkesan.
The rate of reaction depends on the frequency of effective collisions.
Faktor: Suhu / Kepekatan/ Kehadiran mangkin/ Saiz/ Tekanan
Factors: Temperature/ Concentration/ Presence of catalyst/ Pressure



Bahagian C

3. (a) (i) Situasi I: Saiz / *Situation I: Size*
Saiz yang lebih kecil mempunyai jumlah luas permukaan terdedah yang lebih besar.
A smaller size has a bigger total surface area expose.
Situasi 2: Kehadiran mangkin
Situation II: Presence of catalyst

Enzim di dalam yis bertindak sebagai mangkin pada suhu 37 °C.
The enzyme in yeast acts as a catalyst at temperature of 37 °C.
Situasi III: Kepekatan
Situation III: Concentration
Udara di kawasan perindustrian mengandungi kepekatan sulfur dioksida yang tinggi, jadi tahap keasidan hujan bertambah.
The air in industrial areas contains a high concentration of sulphur dioxide, so, the level of acidity of the rain increases.

(b) (i) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

(ii) Eksperimen I / *Experiment I*
Faktor: Suhu dan saiz
Factors: Temperature and size
Apabila suhu bertambah, tenaga kinetik ion hidrogen/ zarah bahan tindak balas bertambah.
Lebih banyak zarah bertenaga untuk mengatasi tenaga pengaktifan.
Frekuensi perlanggaran berkesan antara zarah-zarah meningkat.
When the temperature rises, the kinetic energy of hydrogen ions/ reactant particles increases.
More particles have the energy to overcome the activation energy.
The frequency of effective collisions between particles increases.

Atau / *Or*

Apabila saiz berkurang, jumlah luas permukaan bahan tindak balas bertambah.
Jumlah luas permukaan yang terdedah kepada perlanggaran bertambah.
Frekuensi perlanggaran berkesan antara zarah-zarah meningkat.
When the size decreases, the total surface area of the reactant increases.
The total surface area exposed to collision increases.
The frequency of effective collisions between particles increases.

(c) Hipotesis / *Hypothesis:*
Kehadiran mangkin meningkatkan kadar tindak balas.
Presence of catalyst increases the rate of reaction.

Prosedur / *Procedure:*

1. Masukkan 5.0 cm^3 larutan hidrogen peroksida ke dalam dua tabung uji yang berlabel *P* dan *Q*.
   Put 5.0 cm^3 of hydrogen peroxide solution into two test tubes labeled P and Q.
2. Letakkan tabung uji *P* dan *Q* di dalam rak tabung uji.
   Place test tubes P and Q in a test-tube rack.
3. Masukkan 0.5 g serbuk mangan(IV) oksida ke dalam tabung uji P. Dengan cepat, dekatkan kayu uji berbara ke mulut tabung uji *P* dan tabung uji *Q*.
   Add 0.5 g of manganese(IV) oxide powder into test tube P. Place glowing splinters near the mouth of test tubes P and Q quickly.
4. Rekodkan pemerhatian bagi kedua-dua tabung uji.
   Record the observation for both test tubes.

Tabung uji *P* yang mengandungi mangkin menyalakan semula kayu uji berbara dengan cepat yang menunjukkan bahawa kehadiran mangkin meningkatkan kadar penguraian hidrogen peroksida.
Test tube P which contains the catalyst rekindles the glowing splinter quickly which shows that the presence of catalyst increases the rate of decomposition of hydrogen peroxide.

Praktis Ekstra SPM 7

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

Jawapan

Bab 8

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, Maglev / *brass, steel, Maglev*

Eksperimen 8.1

A Ketahanan kepada kakisan
Resistance to corrosion

Hipotesis / *Hypothesis*:
kakisan / *corrosion*

Pemboleh ubah / *Variables*:
(a) Jenis kepingan / *Type of plate*
(c) Saiz kepingan dan isi padu air suling / *Size of plate and volume of distilled water*

Keputusan / *Results*:

Jenis kepingan *Type of plate*	**Keadaan permukaan kepingan** *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*	Berkarat *Rusty*

B Kekerasan bahan
Hardness of substances

Hipotesis / *Hypothesis*:
keras / *harder*

Pemboleh ubah / *Variables*:
(a) Jenis blok / Type of block
(c) Saiz bola keluli / jisim pemberat / ketinggian pemberat / *Size of steel ball / mass of weight / height of weight*

Prosedur / *Procedure*:

Jenis blok *Type of block*	**Diameter lekuk(cm)** *Diameter of dent*				
	I	**II**	**III**	**IV**	**Purata** *Average*
Kuprum / *Copper*	2.8	2.8	2.9	2.8	2.8
Gangsa / *Bronze*	2.0	2.2	2.1	2.1	2.1

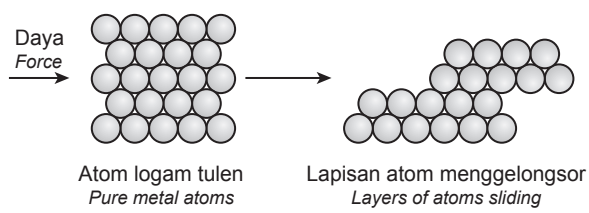
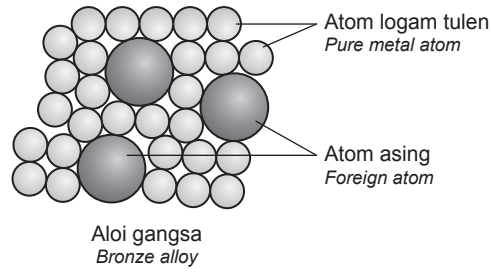
Perbincangan / *Discussion*:

1. lapisan oksida / *oxide layer*
2. rendah / *lower*
3. kecil, keras, kecil / *smaller, stronger, smaller*

Kesimpulan / *Conclusion*:

1. tahan, keras / *resistant, harder*

Perbandingan Sifat Aloi dengan Logam Tulen
Comparison between the Properties of Alloy and Pure Metal

Logam tulen *Pure metal*	**Aloi** *Alloy*
(a) Satu / sama jenis atom dengan saiz atom yang sama *One / same type of atom with the same size*	(b) Campuran atom-atom logam tulen dan atom-atom asing dengan saiz yang berbeza berbanding atom logam tulen *Mixing of pure metal atoms and foreign atoms of different sizes compared to pure metal atom*
(c) Permukaan berkilat *Shiny surface*	(d) Permukaan pudar *Dull surface*
Tahan kakisan *Resistant to corrosion*	Mudah terkakis *Corrode easily*
(e) Atom-atom disusun secara teratur membentuk lapisan-lapisan atom *Atoms are arranged orderly forming layers of atoms*	(f) Susunan teratur lapisan-lapisan atom logam tulen terganggu *The orderly arrangement of pure metal atoms layers is disrupted*
(g) Apabila daya dikenakan, lapisan atom mudah menggelongsor antara satu sama lain *When force is applied, layers of atoms easily slide over each other*	(h) Apabila daya dikenakan, lapisan atom sukar menggelongsor antara satu sama lain *When force is applied, layers of atoms hardly slide over each other.*
(i) Sifat logam tulen: *Properties of pure metal:* (i) Mulur / *Ductile* (ii) Boleh ditempa / *Malleable*	(j) Sifat aloi: *Properties of alloy:* (i) Keras / *Hard*
	

8.2 Aloi dan Kepentingannya
Alloy and Its Importance

1. silikon dioksida, SiO_2 / *silicon dioxide, SiO_2*

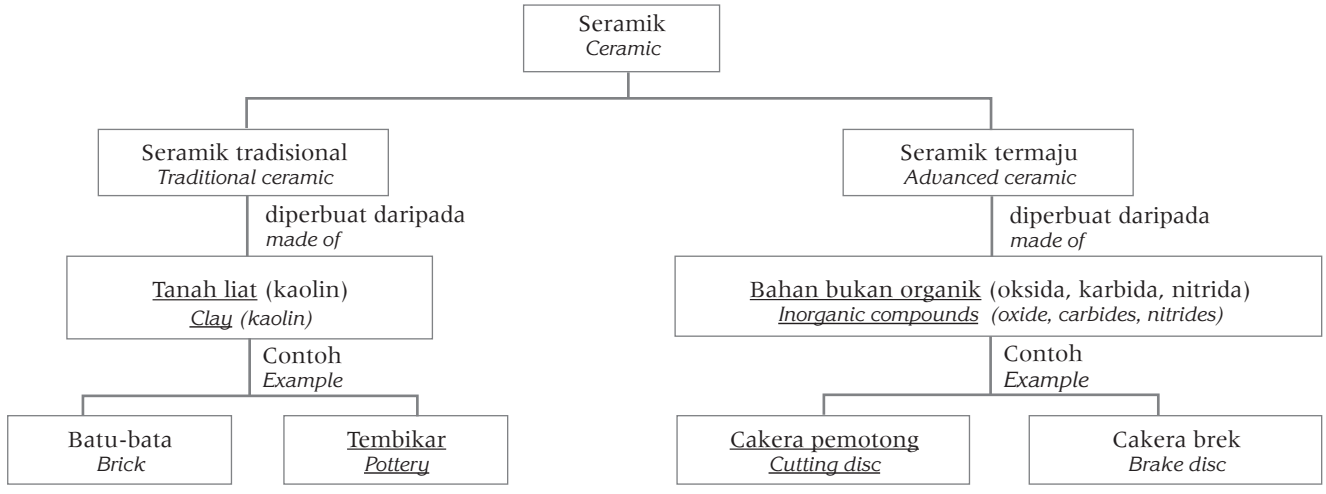
2.

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 when temperature changes*	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 when temperature changes*	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 when temperature changes*	Radas kaca makmal *Laboratory glassware*
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.

Bahan komposit *Composite material*	**Komponen** *Components*		**Sifat-sifat** *Properties*	**Kegunaan** *Use*
	Bahan matriks *Matrix substance*	**Bahan pengukuhan** *Strengthening substance*		
(a) Konkrit yang diperkukuhkan *Reinforced concrete*	Konkrit *Concrete*	Batang keluli atau dawai *Steel bars or wire mesh*	• Kekuatan mampatan dan regangan tinggi *High compression and stretching strength* • Tahan kakisan *Resistant to corrosion*	Pembinaan bangunan, jambatan dan empangan *Construction of buildings, bridges and dams*
(b) Gentian kaca *Fibre glass*	Plastik *Plastic*	Gentian kaca *Glass fibre*	• Kekuatan regangan tinggi *High stretching strength* • Penebat haba dan elektrik *Heat and electrical insulators* • Tahan kakisan *Resistant to corrosion* • Tahan lasak *Durable*	Topi keledar, bumpar kereta *Helmets, car bumper*

(c) Gentian optik *Optical fibre*	• Kaca atau plastik *Glass or plastic* • Jaket pelindung plastik *Plastic protective jacket*	Gentian kaca silika *Silica glass fibre*	• Kekuatan mampatan tinggi *High compression strength* • Fleksibel *Flexible*	Menghantar data dan maklumat dalam bentuk cahaya seperti kamera video dan komputer *Transmit data and information in the form of light such as video camera and computer*
(d) Kaca fotokromik *Photochromic glass*	Kaca *Glass*	• Argentum klorida, AgCl *Silver chloride, AgCl* • Kuprum(I) klorida, CuCl *Copper(I) chloride, CuCl*	• Lut sinar *Transparent* • Menyerap sinar UV *Absorbs UV ray*	Kanta kamera, tingkap kereta dan tingkap bangunan *Camera lens, car windows and building windows*
(e) Superkonduktor *Superconductor*	• Itrium(III) karbonat *Yttrium(III) carbonate* • Kuprum(II) karbonat *Copper(II) carbonate* • Barium karbonat *Barium carbonate* • Oksigen *Oxygen*		Tiada rintangan elektrik pada suhu sangat rendah *No electrical resistance at very low temperature*	Elektromagnet untuk mesin pengimejan resonans magnet (MRI) dan resonans magnet nukleus (NMR) *Produce electromagnet for magnetic resonance imaging (MRI) and nuclear magnetic resonance (NMR) machines.*

Praktis SPM 8

Soalan Objektif

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

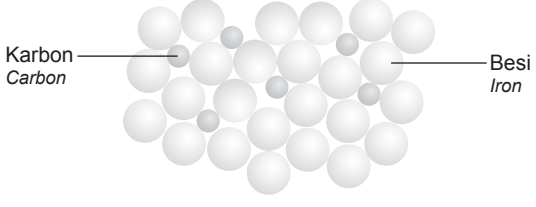
Soalan Subjektif

Bahagian A

1. (a) Campuran dua atau lebih unsur dengan komposisi tetap di mana komponen utama ialah logam
Mixture of two or more elements in a fixed composition where the major component is a metal

(b) (i) Duralumin / *Duralumin*
(ii) Ringan dan kuat // *Light and strong*

(c) (i) Besi dan karbon / *Iron and carbon*
(ii)



Bahagian B

2. (a)

Bahan komposit *Composite material*	Konkrit diperkukuhkan *Reinforced concrete*	Kaca gentian *Fibre glass*
Bahan matriks *Matrix substance*	Konkrit *Concrete*	Plastik *Plastic*
Bahan pengukuhan *Strengthening substance*	Tetulang keluli/ Jejaring dawai *Steel bars/ Wire mesh*	Gentian kaca *Glass fibres*

Kelebihan gentian optik:
Maklumat dan data dihantar dalam bentuk cahaya
Data dibawa dalam kapasiti yang banyak dan tidak terjejas oleh gangguan elektromagnet
Advantages of optical fibre :
Information and data are transmitted in the form of light
Data carried are in large capacity and not influenced by electromagnet disturbances

(b) (i) Kaca: Silika/ Silikon dioksida
Seramik: Tanah liat/ Kaolin
Glass: Silica/ Silicon dioxide
Ceramic: Clay / Kaolin

Dua sifat asas / *Two basic characteristics of:*
Kaca: Lut sinar, kalis air
Glass: Transparent, waterproof

Seramik: Penebat haba, lengai secara kimia
Ceramic: Heat insulator, chemically inert

(ii) Kaca fotokromik bagi menggantikan kaca soda kapur
Kaca fotokromik menjadi gelap apabila terdedah kepada cahaya matahari.
Maka kaca itu dapat melindungi pengguna daripada sinaran UV.
Photochromic glass to replace soda-lime glass
Photochromic glass darkens when it is exposed to sunlight.
So, it can protects users from UV rays.

Konkrit diperkukuhkan bagi menggantikan simen dan konkrit
Dinding menjadi lebih kuat/ mempunyai kekuatan mampatan yang tinggi.
Reinforced concrete to replace cement and concrete
Walls become stronger/ has a high compression strength.

(c) Seramik tradisional diperbuat daripada tanah liat yang dicampurkan dengan air.
Campuran yang terhasil adalah lembut dan mudah dibentuk.
Campuran itu kemudian dibakar pada suhu yang tinggi.
Traditional ceramic is made from clay which is mixed with water.
The mixture produced is soft and easily moulded.
The mixture is then heated at a very high temperature.

Kegunaan: Pembuatan batu-bata dan tembikar
Use: Making bricks and pottery

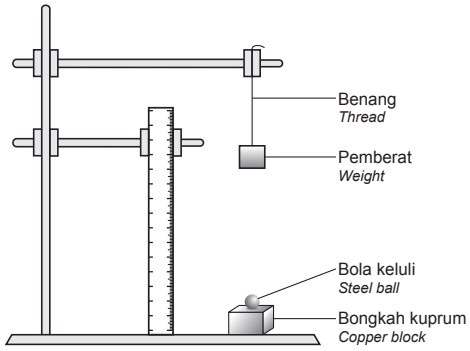
Bahagian C

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 stretching strength // Low density // Easy to colour // Easy to mould and shape
[Mana – mana dua ciri] / [*Any two properties*]

(b) (i) Bahan yang terdiri daripada gabungan dua atau lebih bahan yang bukan homogen iaitu bahan matriks dan bahan pengukuhan
A material made from combining two or more non-homogoneous substances, that is matrix substance and strengthening substance.
Bahan ini mempunyai ciri-ciri yang lebih baik daripada komponen asalnya
This material has properties that are superior than its original components

(ii) Konkrit yang diperkukuhkan:
Reinforced concrete:
Pembinaan bangunan tinggi, pelantar minyak
Construction of high-rise buildings, oil platforms
Kaca fotokromik:/ *Photochromic glass*
Membuat kanta cermin mata, tingkap kereta
Making lens for spectacles, car windows

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



Prosedur / *Procedure:*
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. Lekatkan bola keluli di atas bongkah kuprum menggunakan pita selofan.
Fix a steel ball on the copper block using cellophane tape.
3. Gantungkan pemberat 1 kg 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 bacaan.
Release the weight on the steel ball and measure the diameter of the dent formed. Record the reading.
5. Ulang eksperimen tiga kali pada permukaan berlainan bongkah kuprum.
Repeat the experiment three times on different surfaces of the copper block.
6. Hitung purata diameter lekuk yang terbentuk.
Calculate the average diameter of the dent formed.
7. Ulang langkah 1 hingga 6 menggunakan bongkah gangsa bagi menggantikan bongkah kuprum.
Repeat steps 1 to 6 using a bronze block to replace the copper block.

Pemerhatian: Diameter lekuk yang terbentuk pada bongkah kuprum lebih besar daripada gangsa diameter lekuk yang terbentuk pada bongkah
Observation: The diameter of the dent formed on the copper block is bigger than bronze the diameter of the dent formed on the bronze block.
Kesimpulan: Aloi lebih kuat daripada logam tulennya.
Conclusion: An alloy is harder than its pure metal.

Praktis Ekstra SPM 8

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

JAWAPAN LEMBARAN PBD

Bab 1: Pengenalan kepada Kimia
Introduction to Chemistry

1. Kimia ialah bidang yang berkaitan dengan komposisi, struktur, ciri dan interaksi bagi jirim.
Chemistry is a study related to composition, structure, properties and interaction of matter.

2.

Profesion *Profession*
Ahli geologi *Geologist*
Ahli farmasi *Pharmacist*
Pakar pemakanan *Nutritionist*
Jurutera kimia *Chemical engineer*

3.

	Kaedah *Method*
(a)	Simbah dengan air yang banyak. *Washed with plenty of water.*
(b)	Disapu dengan penyapu dan dibuang ke dalam tempat yang selamat. *Sweep with a broom and throw into a safe place.*

4. A : Sarung tangan
Gloves
B : Kaca mata keselamatan
Safety goggles
C : Kasut bertutup
Closed shoes
D : Kot makmal
Lab coat

Alat pelindung *Protection equipments*
C Kasut bertutup *Closed shoes*
A Sarung tangan *Gloves*
D Kot makmal *Lab coat*
B Kaca mata keselamatan *Safety goggles*

5. • Jangan memanjat meja dalam makmal
Do not climb the table in the laboratory
• Berhati-hati pada lantai yang basah
Be careful of wet floor

6. (a) (i) Radas: Bikar, silinder penyukat, rod kaca, spatula
Apparatus: Beaker, measuring cylinder, glass rod, spatula

(ii) Masukkan 1 spatula serbuk kuprum(II) sulfat ke dalam bikar. Sukat 100 cm^3 air suling. Tuang ke dalam bikar. Kacau hingga semua serbuk larut.
Put 1 spatula copper(II) sulphate powder into a beaker. Measure 100 cm^3 of distilled water. Pour into the beaker. Stir until all the powder dissolves.

(b) (i) Radas: 2 bikar, rod kaca, spatula, corong turas, kertas turas
Apparatus: 2 beakers, glass rod, spatula, filter funnel, filter paper

(ii) Masukkan semua campuran ke dalam bikar. Tuang air suling dan kacau.
Letak kertas turas pada corong turas. Letak bikar di bawah corong turas.
Tuangkan larutan campuran tadi ke dalam corong turas.
Put all the mixture into a beaker. Pour distilled water and stir.
Put filter paper in the filter funnel. Put a beaker below the filter funnel.
Pour the solution mixture into the filter funnel.

(iiii) Pepejal besi terdapat di atas kertas turas manakala larutan garam terdapat di dalam bikar.
Solid iron is on the filter paper while the salt solution is in the beaker.

Bab 2: Jirim dan Struktur Atom
Matter and Atomic Structure

1. Jirim ialah sesuatu yang mempunyai jisim dan memenuhi ruang.
Tiga jenis zarah: atom, ion, molekul
Matter is anything that has mass and occupies space.
Three types of particles: atom, ion, molecule

2. (a) • Petala / *Shells*
• Elektron / *Electron*
• Nukleus / *Nuckleus*
(b) 12, 12, 12, 2.8.2
(c) 24, 25, 26

3. Atom-atom unsur yang sama yang mempunyai nombor proton sama tetapi nombor nukleon yang berbeza.
Atoms of the same element that has the same proton number but different nucleon number .
Perubatan / *Medical*:
Untuk membunuh sel kanser / *To kill the cancer cells*
Industri / *Industry*:
Untuk mengesan kebocoran paip bawah tanah
To detect leakage in underground pipes

4. C-12, $\frac{\Sigma(98.89 \times 12)}{100} = 11.867$, C-13, $\frac{\Sigma(1.11 \times 13)}{100} = 0.144$

Jisim atom relatif bagi karbon = 12.0
Relative atomic mass for carbon

5. (a) (i) *R*: cecair *liquid* *S*: pepejal *solid*
(ii) *R*: molekul *molecule* *S*: ion *ion*

6. Perbincangan/ *Discussion*:
(a) Supaya pemanasan menjadi sekata. / *So that the heating is even.*
(b) Haba diserap untuk mengatasi daya antara molekul/zarah.
Heat is absorbed to overcome the force between molecule /particles.
(c) Supaya haba disebar dengan sekata. / *So that heat is evenly distributed.*

Kesimpulan / *Conclusion*:
(a) pepejal, cecair / *solid, liquid*
(b) pepejal, cecair / *solid, liquid*
(c) sama, 80 °C / *same, 80°C*

Bab 3: Mol, Formula dan Persamaan Kimia
Mole, Formulae and Chemical Equation

1. Pemalar Avogadro, N_A ialah bilangan zarah yang terkandung di dalam 1 mol bahan.
Avogadro Constant, N_A is the number of particles in 1 mole of substance.
Satu mol mengandungi 6.02×10^{23} zarah.
One mole contains 6.02×10^{23} particles.

2. 1 mol gas nitrogen bertindak balas dengan 3 mol gas hidrogen menghasilkan 2 mol gas ammonia.
1 mole of nitrogen gas reacts with 3 mole of hydrogen gas to produce 2 mole of ammonia gas.

3. Bilangan C= 6, H = 12 dan O = 6 , maka formula molekul ialah $C_6H_{12}O_6$
Formula empirik menunjukkan nisbah paling ringkas atom-atom unsur. Maka nisbahnya ialah 1:2:1 dari formula molekulnya. Maka,formula empirik ialah CH_2O.
Number of C = 6, H = 12 and O = 6, so the molecular formula is $C_6H_{12}O_6$
Empirical formula shows the simplest ratio of atoms of the elements. So the ratio is 1:2:1 of the molecular formula. So the empirical formula is CH_2O

4. (a) Kuprum(II) oksida // Plumbum(II)oksida
Copper(II) oxide // Lead(II) oxide
(b) Zink lebih reaktif daripada hidrogen.
Zinc is more reactive than hydrogen.
(c) Serbuk oksida logam membara. Cecair tidak berwarna terhasil.
Metal oxide powder glows. Colourless liquid is produced.

5.

	P	O
Jisim *Mass(g)*	1.92	1.28
Mole *Mol*	$\frac{1.92}{24} = 0.08$	$\frac{1.28}{16} = 0.08$
Nisbah *Ratio*	1	1

Formula empirik ialah *P*O
Empirical formula is PO

6. 1. Potong kad manila pertama mengikut bentuk seperti dalam rajah.
Cut the first manila card according to the shapes as in diagram.
2. Labelkan dengan formula ion positif : Na^+, K^+, Ca^{+2}, Mg^{2+}
Label with positive ion formula : Na^+, K^+ , Ca^{2+}, Mg^{2+}
3. Potong kad manila kedua mengikut bentuk seperti dalam rajah.
Cut the second manila card according to the shapes as in diagram 3.
4. Labelkan dengan formula ion negatif : Cl^- , Br^-, O^{2-}, CO_3^{2-}
Label with negative ion formula : Cl^- , Br^- , O^{2-}, CO_3^{2-}

Na^+	K^+	Ca^+	Mg^{2+}
Cl^-	Br^-	O_2^-	CO_3^{2-}

5. Suaikan kad untuk mendapatkan formula kimia bagi sebatian-sebatian kimia.
Match the cards to get the chemical formula for the chemical substances.

Natrium klorida *Sodium chloride*	Natrium karbonat *Sodium carbonate*
Na^+ Cl^-	Na^+ Na^+ CO_3^{2-}
NaCl	Na_2CO_3

6. Tentukan formula kimia bagi sebatian-sebatian lain.
Determine the chemical formula for other compounds.

Bab 4: Jadual Berkala Unsur
Periodic Table of Elements

1. (a) Magnesium
(b) Klorin / *Chlorine*
(c)

Unsur *Element*
Mangan / Mn *Manganese*
Helium / He *Helium*
Silikon / Si *Silicon*

2. Saiz atom berkurangan. Bilangan proton semakin bertambah. Cas positif dalam nukleus bertambah. Daya antara nukleus dan elektron valens bertambah.
Atomic radius reduces from left to right. Number of protons increases. Positive charges in the nucleus increase. Force between nucleus and valence electron increases.

3. (a) Disimpan di dalam minyak parafin. *X* sangat reaktif terhadap oksigen dan air di dalam udara.
Keep in paraffin oil. X is very reactive towards oxygen and water in the air.

(b) Gas *Y* adalah beracun. Untuk keselamatan, kebuk wasap akan menyerap gas *Y* yang berlebihan.
Gas Y is poisonous. For safety, fume cupboard will absorb excess gas Y.

(c) (i) *XY*
(ii) Pepejal putih terhasil. Ini adalah *XY*. / *White solid is produced. This is XY.*

(d) $2X + Y_2 \longrightarrow 2XY$

(a) 2.8.8.1
(b) Tindak balas sangat aktif dan pantas. Pepejal putih terhasil.
Reaction is vigorous and fast. White solid is produced.

5.

Pemerhatian/ *Observation*
Nyalaan terang // Bergerak laju *Bright flame // Moves fast* Kertas litmus merah bertukar biru // *Red litmus paper turns blue*
Nyalaan sangat terang // Bergerak rawak *Very bright flame // Moves randomly* Kertas litmus merah bertukar biru // *Red litmus paper turns blue*

Perbincangan/ *Discussion*
(a) Kertas litmus merah menjadi biru, menunjukkan larutan beralkali. Larutan adalah larutan natrium hidroksida dan kalium hidroksida
Red litmus paper turns blue, shows alkali solution. Solution is sodium hydroxide and potassium hydroxide solution.
(b) Kalium terletak di bawah natrium di dalam Jadual Berkala Unsur. Saiz atom kalium lebih besar. Daya antara nukleus dengan elektron valen lebih lemah.
Potassium is below sodium in the Periodic Table of Elements. Atomic size of potassium is bigger. The force between the nucleus and valence electron is weaker.
(c) Keringkan pepejal dengan kertas turas // Saiz pepejal mestilah kecil
Dry the solid with filter paper // Size of solid must be small

Kesimpulan / *Conclusion*:
(a) serupa / *same*
(b) lebih / *more*

Bab 5: Ikatan Kimia
Chemical bonds

1. Tidak. Sebab atom neon mempunyai susunan elektron oktet.
No. Because neon atom has octet electron arrangement.

2. Atom natrium mempunyai satu elektron valens. Maka atom natrium menderma satu elektron untuk mencapai susunan elektron oktet.
Sodium atom has one valence electron. So, sodium atom donates one electron to achieve octet electron arrangement.

3. Ikatan logam adalah daya yang kuat antara ion logam bercas positif dan lautan elektron bebas.
Logam dapat mengkonduksi elektrik dengan baik.
The metallic bonding is the strong attraction between positive metal ions and a sea of delocalised electrons.
Metals can conduct electricity well.

4. (a) Sulfur dioksida ialah sebatian kovalen tetapi gas sulfur dioksida masih larut sedikit di dalam air hujan dan menghasilkan hujan asid.
Sulphur dioxide is a covalent compound, but sulphur dioxide gas still dissolves slightly in rainwater and produce acid rain.

(b) $SO_2 + H_2O \longrightarrow H_2SO_3$

5. (a) Plastik ialah sebatian kovalen. Plastik adalah ringan dan tidak larut dalam air.
Plastic is a covalent compound. Plastic are light and insoluble in water.

(b) Gas toksik akan terhasil. Daya antara molekul yang lemah di dalam plastik mudah diatasi oleh haba.
Toxic gas will be produced. The weak force between molecules in plastic is easily overcome by heat.

(c) Guna semula botol yang diperbuat daripada kaca atau bekas keluli tahan karat.
Use recycle glass bottles or stainless-steel containers.
Bawa bekas dan beg sendiri semasa keluar membeli-belah.
Bring own container or beg for shopping
Tidak menggunakan penyedut minuman plastik.
Not using plastic drinking straws

6. (a) Tajuk projek: Pencemaran Plastik Sifar
Project title: Zero Plastic Pollution
Bahan: Risalah pencemaran plastik, 6 kertas manila, pen marker, pin tekan, 10 beg plastik sampah bersaiz besar.
Material: Leaflets on plastic pollution, 6 manila cards, marker pens, thumbtacks. 10 large size garbage bags

(b) (i) Melukis poster tentang pencemaran plastik, kitar semula, guna semula, kurang penggunaan plastik, kesan pencemaran plastik pada haiwan dan manusia.
Poster drawing on plastic pollution, recycle, reuse, reduce plastic usage, effect of plastic pollution to animals and human beings.

(ii) Memasang poster di kantin sekolah dan di dataran rehat pelajar.
Hanging the posters at the school canteen and at students rest area.

(iii) Mengedarkan risalah pencemaran plastik pada pelajar-pelajar dan guru-guru.
Giving out leaflets on plastic pollution to students and teachers.

(iv) Memberi ceramah tentang kesan pencemaran plastik semasa waktu rehat.
Give speech on effects of plastic pollution during recess time.

(v) Mendidik pelajar-pelajar tentang cara-cara untuk mengurangkan pencemaran plastic seperti kitar semula, guna semula, kurang penggunaan plastik.
Educate the students about ways to reduce plastic pollution such as recycle, reuse and reduce the usage of plastic.

Bab 6: Asid, Bes dan Garam
Introduction to Chemistry

1. Asid: Bahan kimia yang mengion dalam air menghasilkan ion hidrogen, H^+
Acid: Chemical substance that ionises in water producing hydrogen ion, H^+
Bes: Bahan kimia yang bertindak balas dengan asid untuk menghasilkan garam dan air.
Base: Chemical substance that reacts with acid to produce salt and water.
Alkali: Bahan kimia yang mengion dalam air menghasilkan ion hidroksida, OH^-
Alkali: Chemical substance that ionises in water producing hydroxide ion, OH^-

2. (i) Pentitratan / *Titration*
(ii) Marmar / *Marbles*
(iii) Neutral / *Neutral*
(iv) Asid lemah / *Weak acid*

3. Kuprum(II) sulfat adalah garam jenis larut. Dihasilkan daripada tindak balas antara kuprum(II) oksida dan asid sulfrik. Larutan kuprum(II) sulfat adalah neutral dan berwarna biru.
Copper(II) sulfat is a soluble salt. Produce from the reaction between copper(II) and sulpfluric acid. Copper(II) sulphate solution is neutral and blue colour.

4. (a) Ammonia mengion separa dalam air menghasilkan kepekatan ion hidroksida yang rendah.
Ammonia ionises partially in water producing a low concentration of hydroxide ions.

(b) *P*: Air / *Water*
Q: Metilbenzena / *Methylbezene*

(c) (i) mol $P = \frac{(0.1)(15)}{1000}$ nisbah mol 2P : H_2SO_4
mole ratio

mol $H_2SO_4 = \frac{1}{2} \times \frac{(0.1)(15)}{1000}$

Kemolaran bagi / *Molarity for* H_2SO_4

$= \frac{1}{2} \times \frac{(0.1)(15) \times 1000}{25 \times 1000}$ mol dm^{-3}

$= 0.03$ mol dm^{-3}

(ii) Ammonium sulfat / *Ammonium sulphate*
Sebagai baja / *As fertiliser*

5. Pemerhatian/ *Observation*
Pepejal hijau menjadi hitam
Green solid becomes black
Air kapur menjadi keruh
Limewater becomes cloudy

Pepejal perang(panas) dan kuning(sejuk)
Brown solid (hot) and yellow(cold)
Air kapur menjadi keruh
Limewater becomes cloudy

Perbincangan/ *Discussion*:

(a) Kuprum(II) karbonat (pepejal hijau) terurai kepada kuprum(II) oksida (pepejal hitam).
Air kapur keruh menunjukkan kehadiran gas karbon dioksida.
Copper(II) carbonate (green solid) decompose to copper(II) oxide (black solid)
Limewater becomes cloudy shows the presence of carbon dioxide gas.

(b) $PbCO_3 \longrightarrow PbO + CO_2^-$

(c) Hujung salur penghantar mesti celup ke dalam air kapur
End of delivery tube must be dipped into limewater

Kesimpulan / *Conclusion*:

(a) oksida logam, karbon dioksida / *metal oxide, carbon dioxide*

Bab 7: Kadar Tindak Balas
Rate of Reaction

1. Kadar tindak balas ialah perubahan kuantiti bahan atau hasil tindak balas dalam satu unit masa.
Rate of reaction is the change in quantity of reactants or products in a unit time.

(a) Suhu / *Temperature*
(b) Jumlah luas permukaan / *Total surface area*
(c) Kepekatan / *Concentration*
(d) Kehadiran mangkin / *Presence of catalyst*

2. (a) Penyesaran air / *Water displacement*
(b) Pertambahan isi padu gas yang terbebas.
Increase in volume of gas released.
Pengurangan jisim bahan tindak balas.
Decrease in the mass of reactant.
(c) Jumlah luas permukaan / *Total surface area*
Kehadiran mangkin / *Presence of catalyst*

3. (a) $Zn + 2HNO_3 \longrightarrow Zn(NO_3)_2 + H_2$

(b) Set I: $\frac{22}{2 \times 60}$ // 0.183 $cm^3\,s^{-1}$

Set II: $\frac{38}{2 \times 60}$ // 0.317 $cm^3\,s^{-1}$

(c) Set II mempunyai kadar tindak balas lebih tinggi. Set II mempunyai suhu yang lebih tinggi. Tenaga kinetik atom Zn dan ion H^+ meningkat. Frekuensi perlanggaran zarah-zarah meningkat.
Maka frekuensi perlanggaran berkesan pun meningkat.
Set II has higher rate of reaction. Set II has higher temperature. The kinetic energy of Zn atom and H^+ ion increases. The frequency of collision between the particles increases.
The frequency of effective collision also increases

(d) mol $HNO_3 = \frac{20 \times 0.2}{1000}$
$= 0.004$ mol

2 HNO_3 : H_2 = 0.004 mol HNO_3 : 0.002 mol H_2

Isi padu / *Volume* $H_2 = 0.002 \times 24\,000$
$= 48\ cm^3$

4. Permerhatian / *Observation*:
Mendakan kuning menutupi pangkah 'X'.
Yellow precipitate covers the 'X' mark.
Semakin kurang kepekatan larutan $Na_2S_2O_3$, semakin lama masa untuk pangkah 'X' hilang.
When the concentration of $Na_2S_2O_3$ solution decreases, the time for mark 'X' to disappear is longer.

Perbincangan/ *Discussion*:

(a) Sulfur / *Sulphur*
(b) Semakin tinggi kepekatan, semakin kecil (singkat) masa.
The higher the concentration, the smaller (shorter) the time.
(c) Semakin tinggi kepekatan, semkin tinggi $\frac{1}{\text{masa}}$.
The higher the concentration, the higher $\frac{1}{time}$.

Kesimpulan / *Conclusion*:

(a) kadar tindak balas / *rate of reaction*

Bab 8: Bahan Buatan Dalam Industri
Manufactured Substances in Industry

1. Suatu campuran dua atau lebih unsur dengan komposisi yang tetap dan tertentu dengan komponen utamanya ialah logam.
Alloy is a mixture of two or more elements with a certain fixed composition with the major component is a metal
Loyang : Untuk membuat alat muzik
Brass : To make musical instruments

2. *P* : Stanum / *tin*
Q : Kuprum / *Copper*

Atom stanum yang lebih besar saiz atomnya akan mengganggu susunan teratur atom kuprum. Lapisan atom kuprum akan dikurangkan daripada menggelongsor di antara satu sama lain.
Tin atoms which have bigger atomic size will disturb the orderly arrangement of the copper atoms. The layers of copper atoms will be reduced from sliding on one another.

3.

Bahan *Substance*
Besi keluli *Stainless steel*
Seramik *Ceramics*
Kaca borosilikat *Borosilicate glass*
Gentian kaca *Fibre glass*
Kaca fotokromik *Photochromic glass*
Kaca plumbum *Lead crystal glass*

4. (a) P: Simen / *Cement*
Q: Keluli / *Steel*
(b) Kelebihan: Sangat kuat, boleh dibentuk menjadi pelbagai bentuk
Advantages : Very strong, can be moulded into various shapes
Kelemahan: Kos yang tinggi, pengecutan
Disadvantages: High cost, shrinkage

5. (a) Kaca / *Glass*
(b) Membuat kabel elektrik. Dapat menghantar data dalam format digital pada kelajuan tinggi.
To make electric cables. Can transmit data in digital format at high speed.
(c) Daya regangan tinggi. Dalam pembuatan struktur bot, topi keledar.
High tensile strength. In manufacturing boat structure, safety helmets.

6. Perbincangan/ *Discussion*:
(a) Karat / *Rust* // Besi oksida / *Iron oxide*
(b) Paku keluli nirkarat kerana ia adalah aloi.
Stainless steel nails because it is an alloy.
(c) Sapu dengan minyak / gris. Tindakan ini akan mengurangkan paku besi terdedah kepada udara dan air.
Wipe with oil / grease. These actions will reduce the exposure to air and water.
Kesimpulan / Conclusion:
(a) keluli nirkarat / *Stainless steel*
(b) kakisan / *corrosion*