SET PECUTAN KIMIA

F4 BAB 7

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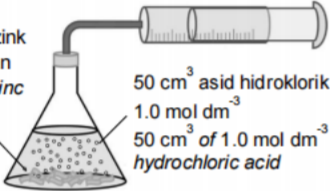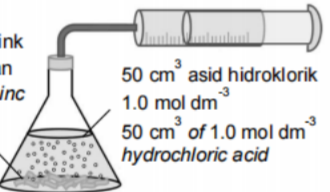Tiktok: https://www.tiktok.com/@cikuhau
Telegram: https://t.me/spmphysics_23

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Jadual 2 menunjukkan dua eksperimen yang dijalankan untuk mengkaji faktor yang mempengaruhi kadar tindak balas.
Table 2 shows two experiments carried out to study the factor that affects the rate of reaction.

Eksperimen *Experiment*	Susunan radas *Set-up of apparatus*	Masa yang diambil untuk mengumpul 60 cm³ gas (s) *Time taken to collect 60 cm³ gas (s)*
I	Ketulan zink berlebihan *Excess zinc granules* 50 cm³ asid hidroklorik 1.0 mol dm⁻³ *50 cm³ of 1.0 mol dm⁻³ hydrochloric acid*	80
II	Serbuk zink berlebihan *Excess zinc powder* 50 cm³ asid hidroklorik 1.0 mol dm⁻³ *50 cm³ of 1.0 mol dm⁻³ hydrochloric acid*	30

(a) Berikan satu faktor yang boleh mempengaruhi kadar tindak balas.
Give one factor that can affects the rate of reaction.

....

[1 markah/ *mark*]

(b) Berdasarkan Jadual 2, nyatakan satu sebab mengapa isipadu akhir gas yang diperolehi dalam eksperimen I dan eksperimen II adalah sama.
Based on Table 2, state one reason why the final volume of gas obtained in experiments I and II are the same.

....

[1 markah/ *mark*]

(c) (i) Hitung kadar tindak balas purata bagi :
Calculate the average rate of reaction for :

Eksperimen I
Experiment I

Eksperimen II
Experiment II

[2 markah/ *marks*]

(ii) Tuliskan persamaan kimia bagi eksperimen itu.
Write a chemical equation for the experiment.

....

[2 markah/ *marks*]

(iii) Bandingkan kadar tindak balas bagi Eksperimen I dan Eksperimen II. Terangkan jawapan anda.
Compare the rate of reaction between Experiment I *and Experiment* II. *Explain your answer.*

....

....

....

[3 markah/ *marks*]

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				Markah	Markah
(a)		**[Dapat menyatakan faktor yang dapat mempengaruhi kadar tindak balas dengan betul]** Contoh jawapan: Saiz bahan tindak balas // suhu // kepekatan // kehadiran mangkin // tekanan // *Size of reactant // temperature // concentration // presence of catalyst // pressure*	1		1
(b)		**[Dapat menyatakan dengan betul sebab isipadu akhir gas yang diperolehi dalam eksperimen I dan eksperimen II adalah sama]** Contoh jawapan: Bilangan mol ion hidrogen / asid dalam eksperimen I dan II adalah sama // *Number of moles of hydrogen ions / acid in experiments I and II are the same.*	1		1
(c)	(i)	**[Dapat menghitung kadar tindak balas purata dengan nilai dan unit yang betul]** Contoh jawapan: Eksperimen I // *Experiment* I $\dfrac{60\ cm^3}{80\ s}$ // $0.75\ cm^3\ s^{-1}$ Eksperimen II // *Experiment* II $\dfrac{60\ cm^3}{30\ s}$ // $2.00\ cm^3\ s^{-1}$	1 1		2
	(ii)	**[Dapat menulis persamaan kimia dengan betul]** Formula bahan tindak balas dan hasil tindak balas Persamaan seimbang Jawapan: $2HCl + Zn \rightarrow ZnCl_2 + H_2$	1 1		2
	(iii)	**[Dapat membuat perbandingan kadar tindak balas antara eksperimen I dan II dengan betul]** Contoh jawapan: 1. Kadar tindak balas eksperimen II lebih tinggi daripada eksperimen I // *The rate of reaction in experiment II is higher than experiment I.*	1		3

2. Saiz zink dalam eksperimen II lebih kecil berbanding eksperiment I //
Size of zinc in experiment II is smaller than experiment I. — 1

3. Jumlah luas permukaan zink dalam eksperimen II lebih besar berbanding eksperiment I //
Total surface area of zinc in experiment II is larger than experiment I. — 1

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Jadual 2 menunjukkan maklumat bagi eksperimen I, eksperimen II dan eksperimen III.
Table 2 shows the information of experiment I, experiment II and experiment III.

Eksperimen *Experiment*	Keadaan bahan tindak balas *Condition of reactants*	Masa yang di ambil untuk mengumpul 40 cm³ gas (s) *Time taken to collect 40 cm³ of gas (s)*
I	Ketulan zink berlebihan + 25 cm³ asid hidroklorik 0.2 mol drn³ *Excess zinc granules + 25 cm³ of 0.2 mol dm⁻³ hydrochloric acid*	90
II	Serbuk zink berlebihan + 25 cm³ asid hidroklorik 0.2 mol drn³ *Excess zinc powder + 25 cm³ of 0.2 mol drn⁻³ hydrochloric acid*	55
III	Serbuk zink berlebihan + 25 cm³ asid hidroklorik 0.2 mol drn³ +larutan kuprum(II) sulfat *Excess zinc powder + 25 cm³ of 0.2 mol drn³ hydrochloric acid + copper(II) sulphate solution*	30

Jadual 2 /*Table 2*

Berdasarkan maklumat yang diberikan dalam Jadual 2:
Based on the information given in Table 2:

(a) Nyatakan maksud kadar tindak balas dalam eksperimen ini.
State the meaning of rate of reaction for this experiment.

....
[1 *markah/mark*]

(b) (i) Eksperimen yang manakah menunjukkan kadar tindak balas paling tinggi?
Which experiment shows the highest rate of reaction?

....
[1 *markah/mark*]

(ii) Hitung kadar tindak balas di b(i).
Calculate average rate of reaction in b(i).

[1 *markah/mark*]

(c) Nyatakan faktor yang mempengaruhi kadar tindak balas bagi eksperimen II dan III.
State the factor that influence the rate of reaction for experiment III.

....
[1 *markah/mark*]

(d) Tulis persamaan kimia bagi tindak balas antara zink dan asid hidroklorik.
Write the chemical equation for the reaction between zinc and hydrochloric acid.

....
[2 *markah/marks*]

(e) Bandingkan kadar tindak balas bagi eksperimen I dan eksperimen II.
Dengan menggunakan teori pelanggaran,terangkan jawapan anda.
Compare the rate of reaction for experiment I and experiment II.By using collision theory, explain your answer.

....
....
....
....
....
[4 *markah/marks*]

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(a)		Perubahan <u>kuantiti</u> gas hydrogen per unit masa *A change of amount of hydrogen gases per unit time* a : isipadu	1
(b)	(i)	Eksperimen III *Experiment III*	1
	(iii)	Kadar tindak balas = 1.33 <u>cm</u> $cm^3 \ s^{-1}$ (unit perlu ada) *Rate of reaction = 1.33 $cm^3 \ s^{-1}$* a: $\dfrac{40 \ cm^3 \ s^{-1}}{30}$	1
(c)	(i)	Kehadiran pemangkin/ *catalyst* a : mangkin	1
(d)		$Zn + 2HCl \rightarrow MgCl_2 + H_2$ Formula bahan dan hasil tepat *Correct formula for reactang and product* Persamaan seimbang *Balance equation*	1 1

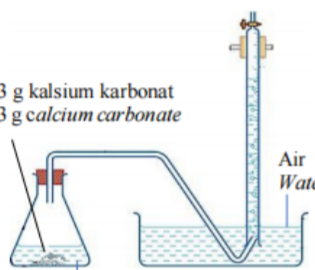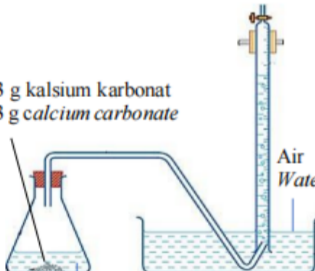| (e)	1. Kadar tindak balas eksperimen II lebih tinggi daripada ekperimen I *The rate of reaction in experiment II is higher than experiment I*	1
	2. Saiz zink dalam eksperimen II lebih kecil daripada eksperimen I *Size of zinc in experiment II is smaller then experiment I*	1
	3. Jumlah luas permukaan zink dalam eksperimen II lebih tinggi daripada eksperimen I *Total surface area of zinc in experiment II is smaller then experiment I*	1
	4.Frekuensi pelanggaran diantara atom zink dan ion hydrogen, H⁺ lebih tinggi *The frequency of collision between zinc atoms and hydrogen ions in experiment II higher than experiment I* 5 .Frekuensi pelanggaran berkesan eksperimen II lebih tinggi daripada eksperimen I *The frequency of effective collision in experiment II higher than experiment I* Note : perlu ada point 4 &5 untuk mendapat markah ke-4	1
	TOTAL	**10**

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Rajah 6.1 menunjukkan susunan radas dan pemerhatian bagi dua set eksperimen yang telah dijalankan di makmal.

Rajah 6.1 shows the apparatus set-up and the observations of two set of experiment that has been carried out in a laboratory.

| Set / *Set*	Susunan radas / *Apparatus set up*	Suhu / *Temperature*	Masa yang diambil untuk mengumpulkan 50 cm³ gas CO_2 (s) / *Time taken to collect 50 cm³ CO_2 gas (s)*
I	3 g kalsium karbonat / 3 g *calcium carbonate* — Air / *Water* — 50 cm³ asid hidroklorik 1.0 mol dm⁻³ / 50 cm³ of 1.0 mol dm⁻³ *hydrochloric*	30	12.0
II	3 g kalsium karbonat / 3 g *calcium carbonate* — Air / *Water* — 50 cm³ asid hidroklorik 0.5 mol dm⁻³ / 50 cm³ of 0.5 mol dm⁻³ *hydrochloric*	30	30.0

(a) Berdasarkan Rajah 6.1, kenalpasti faktor yang mempengaruhi kadar tindak balas.

Based on Diagram 6.1, *identify the factor that affects the rate of reaction.*

....

[1 markah/ *mark*]

(b) Nyatakan pemerhatian apabila gas karbon dioksida, CO_2 diuji menggunakan air kapur.

State the observation when carbon dioxide, CO_2 gas is tested by using limewater.

....

[1 markah/*mark*]

(c) Berikut merupakan persamaan kimia bagi tindak balas dalam eksperimen tersebut.

The following is the chemical equation for the reaction in the experiment.

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$
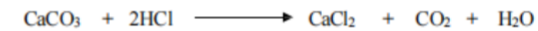
Hitungkan jisim kalsium karbonat yang tidak bertindak balas dalam Set I.

[Jisim Molar bagi kasium karbonat, $CaCO_3 = 100$ g mol⁻¹]

Calculate the mass of calcium carbonate that not reacted in Set I.

[*Molar mass of calcium carbonate*, $CaCO_3 = 100$ g mol⁻¹]

[4 markah/*marks*]

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(d) Rajah 6.2 menunjukkan lengkung III yang diperolehi dengan mengulangi eksperimen I dengan pepejal kalsium karbonat dihancurkan dan suhu ditingkatkan sebanyak dua kali ganda.

Berdasarkan maklumat pada diagram 6.1, lakarkan graf isipadu gas terbebas melawan masa untuk Set I dan Set II pada paksi yang sama.

Diagram 6.2 shows the curve III obtained by repeating the experiment I with solid calcium carbonate that is crushed and the temperature is doubled.

Based on the information in diagram 6.2, sketch a graph of the volume of gas released against time for Set I and Set II on the same axes.

Isipadu gas karbon dioksida (cm³)
Volume of carbon dioxide gas (cm³)
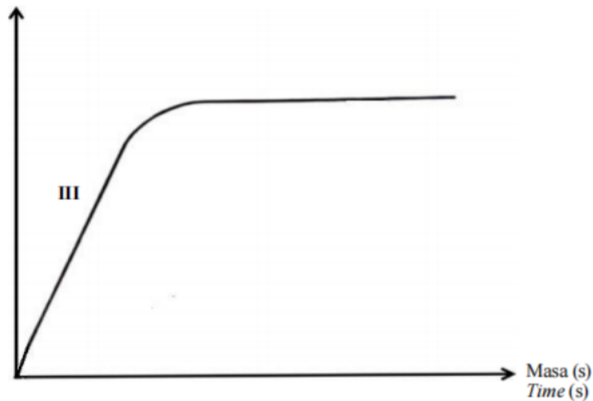
Rajah 6.2
Diagram 6.2

[2 markah/*marks*]

(e) En. Faizal dan keluarga berkelah di tepi air terjun. En. Faizal membawa bahan seperti ayam, arang dan pisau untuk menyediakan ayam bakar. Cadangkan satu kaedah yang boleh dilakukan oleh En. Faizal dan jelaskan bagaimana kaedah tersebut boleh membantu En Faizal memastikan ayam tersebut masak dengan cepat.

Mr. Faizal and his family had a picnic by the waterfall. Mr. Faizal bring materials such as chicken, charcoal and knife to prepare grilled chicken. Suggest a method that can be done by Mr. Faizal and explain how the method can help Mr. Faizal ensure that the chicken cooks quickly.
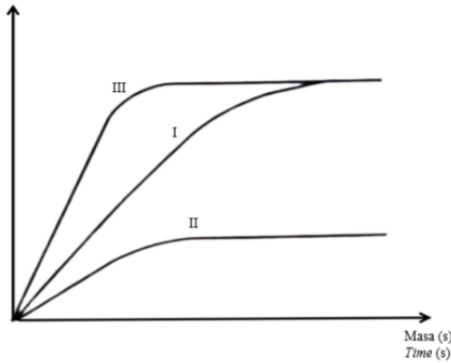
....

....

....

[2 markah /*marks*]

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(a)	**[Dapat mengenal pasti faktor yang mempengaruhi kadar tindak balas dengan betul]** Contoh jawapan: Kepekatan asid hidroklorik // *Concentration*	1
(b)	**[Dapat menyatakan pemerhatian dengan betul]** Jawapan: Air kapur berubah menjadi keruh // *Air kapur turns cloudy/ milky/ chalky*	1

(c)	**[Dapat menghitung jisim kalsium karbonat yang tidak bertindak balas dalam Set I dengan betul]**	
	3. Bilangan mol HCl	1
	4. Nisbah mol	1
	5. Jisim kalsium karbonat yang bertindak balas	1
	6. Jisim kalsium karbonat yang tidak bertindak balas dengan unit yang betul	1

Contoh jawapan:

3. Bil mol HCl $= \frac{50 \times 1.0}{1000} = 0.05$ mol

4. 2 mol HCl bertindak balas dengan 1 mol CO_2 // 0.05 mol C_5H_{12} *reacts with* 0.025 mol CO_2

5. Jisim $CaCO_3$ bertindak balas $= 0.025 \times 100$ // 2.5 *Mass of* $CaCO_3$ *reacted*

6. Jisim $CaCO_3$ tidak bertindak balas *Mass of* $CaCO_3$ *reacted* $= (3.0 - 2.5)$ g // 0.5 g

(c)	**[Dapat melakar graf bagi Set I dan II dengan betul]**	
	1. Bentuk graf yang betul	1
	2. Label lengkung graf eksperimen	1

Contoh jawapan:

(d)	**[Dapat mencadangkan satu kaedah dan menerangkan bagaimana keadah itu membolehkan ayam dimasak dengan cepat dengan betul]**	
	Contoh jawapan:	
	1. Memotong ayam menjadi saiz lebih kecil *Cut the chicken into smaller size*	1
	2. Jumlah luas permukaan ayam terdedah pada haba lebih tinggi *Total surface area of chicken expose to heat is larger*	1

atau

1. Memecahkan arang menjadi kepingan lebih kecil *Brake the coal into smaller pieces*
2. Jumlah luas permukaan untuk api pembakaran lebih besar /// menghasilkan suhu yang lebih tinggi/ *Total surface area for combustion is bigger // Can produced higher temperature*

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Dua set eksperimen telah dijalankan untuk mengkaji faktor yang mempengaruhi kadar tindak balas. Jadual 5 menunjukkan masa yang diambil bagi mengumpul 40 cm³ gas hidrogen.

Two sets of experiment are carried out to investigate the factor that affect the rate of reaction. Table 5 shows the time taken to collect 40 cm³ of hydrogen gas.

Set set	Bahan tindak balas *Reactants*	Masa yang diambil untuk mengumpul 40 cm³ gas hidrogen (s) *Time taken to collect 40 cm³ of hydrogen gas (s)*
I	Serbuk zink berlebihan + 25 cm³ asid HX 0.2 mol dm⁻³ *Excess zinc powder +* 25 cm³ of 0.2 mol dm⁻³ HX acid	90
II	Serbuk zink berlebihan + 25 cm³ asid H₂Y 0.2 mol dm⁻³ *Excess zinc powder +* 25 cm³ of 0.2 mol dm⁻³ H₂Y acid	40

Jadual 5 / *Table 5*

(a) Nyatakan perubahan lain yang boleh diukur selain daripada isi padu gas untuk menentukan kadar tindak balas dalam eksperimen ini.

State another measurable changes besides volume of gas to determine the rate of reaction in this experiment.

[1 markah / *mark*]

(b) Rajah 5 menunjukkan graf isipadu gas hidrogen melawan masa bagi set II.

Diagram 5 shows graph volume of hydrogen gas against time of set II.

Isipadu gas hidrogen /cm³
Volume of hydrogen gas / cm³
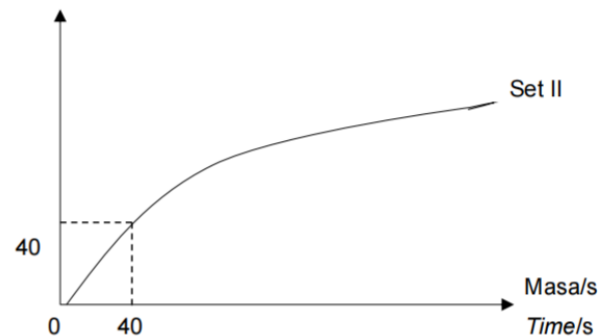
Rajah 5 / Diagram 5

Lakar dan labelkan lengkung bagi Set I pada paksi yang sama dalam Rajah 5 apabila tindak balas telah lengkap.

Sketch and label the curve of Set I on same axes in Diagram 5 when the reaction completed.

[1 markah / *mark*]

(c) (i) Tuliskan persamaan ion bagi eksperimen ini.

Write an ionic equation of this experiment.

[2 markah / *marks*]

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(ii) Hitung kadar tindak balas purata bagi mengumpul 40 cm³ gas dalam Set I dan Set II.

Calculate the average rate of reaction to collect 40 cm³ *of gas in Set I and Set II.*

Set I :   Set II :

[2 markah / *marks*]

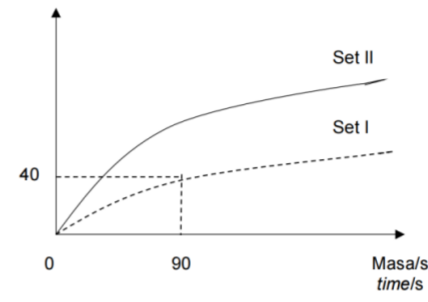(iii) Bandingkan kadar tindak balas bagi Set I dan Set II. Terangkan.

Compare the rate of reaction of Set I and Set II. Explain.

_____

_____

[2 markah / *marks*]

(a)		Jisim zink	
		Mass of zinc	
(b)		Isipadu gas hidrogen/cm³	
		Volume of hydrogen gas/cm³	

Rajah 5 / *Diagram 5*

Bentuk graf yang betul
Correct graph shape

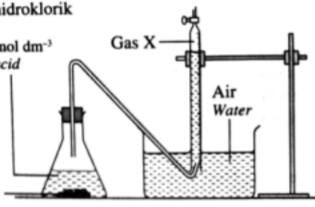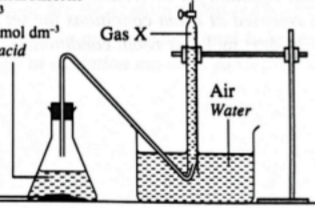| (c)	(i)	1.Formula bahan dan hasil betul	1
		Correct formula of reactant and product	
		2.Seimbang	1
		Balanced	
		$Zn + 2H^+ \longrightarrow Zn^{2+} + H_2$	
	(ii)	Set I : $\dfrac{40\ cm^3}{90\ s}$ / 0.44 cm³ s⁻¹	1
		Set II : $\dfrac{40\ cm^3}{40\ s}$ / 1.00 cm³ s⁻¹	1
		[minimum 2 titik perpuluhan] / [*minimum 2 decimal places*]	
	(iii)	1.Kadar tindak balas set II lebih tinggi daripada set I	1
		Rate of reaction of set II is higher than set I	
		2.Kepekatan ion H⁺ dalam set II adalah dua kali daripada set I / HX adalah asid monoprotik manakala H₂Y adalah asid diprotik.	1
		Concentration of H⁺ in set II is double than set I / HX is monoprotic acid while H₂Y is diprotic acid.	

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(a) Jadual 10.1 menunjukkan dua set eksperimen yang dijalankan oleh seorang murid untuk mengkaji faktor yang mempengaruhi kadar tindak balas antara asid hidroklorik dengan kalsium karbonat berlebihan
Table 10.1 *shows two sets of experiments carried out by a student to study the factor that affects the rate of reaction between hydrochloric acid and excess calcium carbonate.*

Set	Susunan radas *Apparatus set up*	Masa yang diambil untuk mengumpul 40 cm³ gas karbon dioksida (s) *Time taken to collect 40 cm³ of carbon dioxide gas* (s)
I	50 cm³ asid hidroklorik 0.1 mol dm⁻³ *50 cm³ of 0.1 mol dm⁻³ hydrochloric acid* Gas X Air / *Water* Ketulan kalsium karbonat *Calcium carbonate granules*	50
II	50 cm³ asid hidroklorik 0.1 mol dm⁻³ *50 cm³ of 0.1 mol dm⁻³ hydrochloric acid* Gas X Air / *Water* Serbuk kalsium karbonat *Calcium carbonate powder*	20

Jadual 10.1 / *Table* 10.1

(i) Nyatakan definisi bagi kadar tindak balas.
State the definition of the rate of reaction.

[1 markah/1 *mark*]

(ii) Hitung kadar tindak balas purata dalam set I.
Calculate the average rate of reaction in set I.

[1 markah/1 *marks*]

(iii) Berdasarkan maklumat dalam Jadual 10.1, bandingkan kadar tindak balas antara set I dengan set II. Terangkan jawapan anda menggunakan teori perlanggaran.
Based on the information in Table 10.1, *compare the rate of reaction between set* I *and set* II
Explain your answer by using the collision theory.

[5 markah/5 *marks*]

(iv) Lakarkan graf isi padu gas karbon dioksida yang terkumpul melawan masa bagi eksperimen dalam set I dan set II pada paksi yang sama.
Sketch a graph of the volume of carbon dioxide gas collected against time for the experiments in set I *and set* II *on the same axis.*
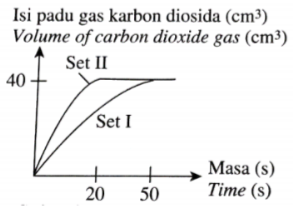
[2 markah/2 *marks*]

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(a)	(i)	Kadar tindak balas ialah perubahan kuantiti bahan tindak balas per unit masa atau perubahan kuantiti hasil tindak balas per unit masa. *The rate of reaction is the change in the quantity of the reactant per unit time or the change in the quantity of the product per unit time.*	1
	(ii)	Set I $= \dfrac{40}{50}$ $// 0.8 \ cm^3 \ s^{-1}$	1
	(iii)	-Kadar tindak balas bagi set II lebih tinggi daripada set I. *The rate of reaction for set II is higher than that of set I.*	1
		-Saiz kalsium karbonat dalam set II lebih kecil daripada saiz kalsium karbonat dalam set I *The total surface area of calcium carbonate that is exposed to acid in set II is larger than in set I.*	1
		Jumlah luas permukaan kalsium karbonat yang terdedah kepada asid dalam set II lebih besar daripada dalam set I. *The size of calcium carbonate in set II is smaller than the size of calcium carbonate in set I*	1
		-Frekuensi perlanggaran antara kalsium karbonat dengan ion hidrogen dalam set II lebih tinggi daripada dalam set I. *The frequency of collision between calcium carbonate and hydrogen ions in set II is higher than in set I.*	1
		-Frekuensi perlanggaran berkesan antara kalsium karbonat dengan ion hidrogen dalam set II lebih tinggi daripada dalam set I. *The frequency of effective collision between calcium carbonate and hydrogen ions in set II is higher than in set I.*	1
	(iv)	Isi padu gas karbon diosida (cm³) *Volume of carbon dioxide gas (cm³)*	

(b) Suatu eksperimen dijalankan untuk mengkaji kadar tindak balas antara zink dengan asid nitrik. Dalam eksperimen itu, ketulan zink berlebihan bertindak balas dengan 25 cm³ asid nitrik bagi set III dan set IV. Jadual 10.2 menunjukkan keputusan yang diperolehi daripada eksperimen itu.
An experiment is carried out to study the rate of reaction between zinc and nitric acid. In the experiment, excess zinc granules react with 25 cm³ of nitric acid for set III and set IV. Table 10.2 shows the results obtained from the experiment.

Set	Kepekatan asid nitrik (mol dm⁻³) *Concentration of nitric acid (mol dm⁻³)*	Suhu (°C) *Temperature (°C)*	Kadar tindak balas *Rate of reaction*
III	0.2	27	Rendah *Low*
IV	1.0	37	Tinggi *High*

Jadual 10.2/*Table* 10.2

(i) Berdasarkan maklumat dalam Jadual 10.2, nyatakan dua faktor yang mempengaruhi kadar tindak balas. Pilih satu daripada faktor itu dan terangkan jawapan anda menggunakan teori perlanggaran.
Based on the information in Table 10.2, state two factors that affect the rate of reaction. Choose one of the factors and explain your answer using the collision theory.

[6 markah/6 *marks*]

(ii) Tulis persamaan kimia seimbang bagi tindak balas antara asid nitrik dengan zink. Hitung isi padu maksimum gas yang terbebas pada keadaan bilik bagi set III.
[Isi padu molar gas = 24 dm³ mol⁻¹ pada keadaan bilik]
Write a balanced chemical equation for the reaction between nitric acid and zinc. Calculate the maximum volume of gas released at room conditions for set III.
[*Molar volume of gas = 24 dm³ mol⁻¹ at room conditions*]

[5 markah/5 *marks*]

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(b) (i)

Suhu dan kepekatan *Temperature and concentration* Suhu *Temperature*	1	
1.Suhu asid nitrik dalam set IV lebih tinggi daripada dalam set III. *The temperature of nitric acid in set IV is higher than in set III.*	1	
2.Dalam set IV, tenaga kinetik ion hidrogen dan atom zink lebih tinggi. **Lebih banyak zarah bertenaga untuk mengatasi tenaga pengaktifan** *In set IV, kinetic energy between hydrogen ion dan zinc atom is higher.*	1	
3.Frekuensi perlanggaran antara atom zink dengan ion hidrogen dalam set IV lebih tinggi daripada dalam set III. *The frequency of collision between zinc atoms and hydrogen ions in set IV is higher than in set III*	1	
4.Frekuensi perlanggaran berkesan antara zarah dalam set IV lebih tinggi daripada dalam set III. *The frequency of effective collision between zinc atoms and hydrogen ions in set IV is higher than in set III.*	1	
5.Kadar tindak balas bagi set IV lebih tinggi daripada set III. *The rate of reaction for set IV is higher than set III*	1	

ATAU

Kepekatan/*Concentration*

1.Kepekatan asid nitrik dalam set IV lebih tinggi daripada dalam set III. *The concentration of nitric acid in set IV is higher than in set III.*	1
2.Bilangan ion hidrogen per unit isi padu asid dalam set IV lebih tinggi daripada dalam set III. *The number of hydrogen ions per unit volume in set IV is higher than in set III.*	1

3.Frekuensi perlanggaran antara atom zink dengan ion hidrogen dalam set IV lebih tinggi daripada dalam set III. *The frequency of collision between zinc atoms and hydrogen ions in set IV is higher than in set III.*	1
4.Frekuensi perlanggaran berkesan antara zarah dalam set IV lebih tinggi daripada dalam set III. *The frequency of effective collision between particles in set IV is higher than in set III.*	1
5.Kadar tindak balas bagi set IV lebih tinggi daripada set III. *The rate of reaction for set IV is higher than set III.*	1

(ii)

Formula kimia bahan dan hasil tindak balas betul Persamaan kimia seimbang $2HNO_3 + Zn \rightarrow Zn(NO_3)_2 + H_2$	1+1
Bilangan mol bagi HNO_3 *Number of moles of* HNO_3 $= \dfrac{(0.2)(25)}{1\ 000}$ 0.005 mol HNO_3	1
Daripada persamaan kimia itu, *From the chemical equation,* 2 mol HNO_3 menghasilkan 1 mol H_2 2 mol of HNO_3 *produce* 1 mol of H_2	
0.005 mol HNO_3 menghasilkan 0.0025 mol H_2 0.005 mol of HNO_3 *produce* 0.0025 mol of H_2	1
- Isi padu bagi H_2 / *Volume of* H_2 $= 0.0025 \times 24$ $= 0.06$ dm³/60 cm³	1

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Tiga eksperimen, I, II dan III dijalankan untuk mengkaji faktor-faktor yang mempengaruhi kadar tindak balas.
Jadual 5 menunjukkan bahan tindak balas dan keadaan tindak balas yang terlibat.
Three experiments, I, II and III are carried out to investigate the factors affecting the rate of reaction.
Table 5 shows the reactants and the conditions of reactions involved.

Eksperimen Experiment	Bahan tindak balas Reactants		Keadaan tindak balas Condition of reaction
I	Zink berlebihan Excess zinc	50 cm³ asid hidroklorik 0.5 mol dm⁻³ 50 cm³ of 0.5 mol dm⁻³ hydrochloric acid	Suhu bilik Room temperature
II	Zink berlebihan Excess zinc	50 cm³ asid sulfurik 0.5 mol dm⁻³ 50 cm³ of 0.5 mol dm⁻³ sulphuric acid	Suhu bilik Room temperature
III	Zink berlebihan Excess zinc	50 cm³ asid sulfurik 0.5 mol dm⁻³ 50 cm³ of 0.5 mol dm⁻³ sulphuric acid	60°C

Jadual 5
Table 5

Berdasarkan Jadual 5,
Based on Table 5,

(a) nyatakan maksud kadar tindak balas dan jenis zarah bagi zink.
   state the meaning of rate of reaction and types of particles of zinc.

[2 markah]
[2 marks]

(b) tulis persamaan kimia bagi tindak balas dalam eksperimen I dan hitungkan jisim zink klorida yang terhasil.
   write a chemical equation for the reaction in experiment I and calculate the mass of zinc chloride formed.
   [Jisim atom relatif: Zn = 65; Cl = 35.5]
   Relative atomic mass: Zn = 65; Cl = 35.5]

[6 markah]
[6 marks]

(a)	Kadar tindak balas ialah perubahan kuantiti bahan tindak balas per unit masa // perubahan kuantiti hasil tindak balas per unit masa *Rate of a reaction is the change in quantity of reactant per unit time //* *the change in quantity of the reaction product per unit time*	1
	Jenis zarah : atom *Types of particles : atom*	1

| (b)	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$	
	- Formula kimia bahan dan hasil tindak balas betul *Correct chemical formula of the reactant and product*	1
	- Persamaan seimbang *Balanced equation*	1
	bil. mol HCl = $\dfrac{0.5 \times 50}{1000}$ = 0.025 mol	1
	daripada persamaan, $\dfrac{\text{bil. mol HCl}}{\text{bil. mol ZnCl}_2} = \dfrac{2}{1}$	
	Jisim molar $ZnCl_2$ = 65 + 2(35.5) = 136	1
	bil. mol $ZnCl_2$ = $\dfrac{1 \times \text{bil. mol HCl}}{2}$ = 0.0125 mol	1
	Jisim $ZnCl_2$ = bil. mol $ZnCl_2$ x Jisim molar = 0.0125 x 136 = 1.7 g	1

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(c) Rajah 10 menunjukkan keputusan bagi eksperimen I, II dan III.
Diagram 10 shows the results of experiments I, II and III.

Isi padu gas hidrogen (cm^3)
Volume of hydrogen gas (cm^3)
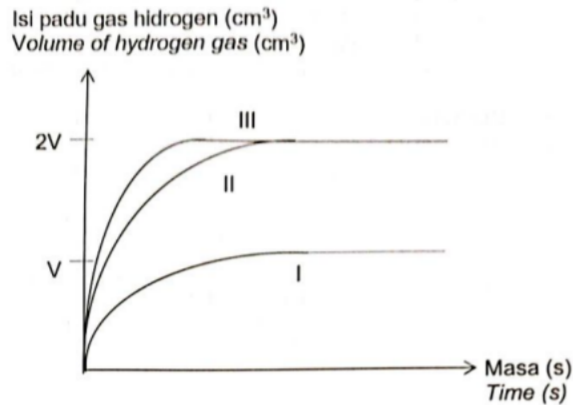
Rajah 10
Diagram 10

Berdasarkan Rajah 10,
Based on the Diagram 10,

(i) banding kadar tindak balas antara eksperimen I dan experiment II.
Jelaskan jawapan anda menggunakan Teori Perlanggaran.
compare the rate of reaction between experiment I and experiment II.
Explain your answer using the Collision Theory.

[5 markah]
[5 *marks*]

(ii) cadangkan satu cara untuk memperoleh lengkungan III tanpa mengubah zink, asid atau suhu dalam eksperimen II.
Jelaskan jawapan anda menggunakan Teori Perlanggaran.
suggest one way to obtain curve III without changing the zinc, acid or temperature in experiment II.
Explain your answer using the Collision Theory.

[5 markah]
[5 *marks*]

(iii) terangkan mengapa jumlah isi padu gas hidrogen yang dibebaskan dalam eksperimen II adalah dua kali ganda eksperimen I.
explain why the total volume of hydrogen gas released in experiment II is doubled that of experiment I.

[2 markah]
[2 *marks*]

(c)	(i)	- Kadar tindak balas Eksperimen II lebih tinggi berbanding Eksperimen I	1
		- Asid yang digunakan dalam Eksperimen II ialah asid diprotik manakala dalam Eksperimen I adalah asid monoprotik	1
		- Bilangan ion H^+ per unit isi padu dalam Eksperimen II lebih tinggi berbanding dalam Eksperimen I	1
		- Frekuensi perlanggaran di antara ion H^+ dengan atom zink dalam Eksperimen II lebih tinggi berbanding dalam Eksperimen I	1
		- Frekuensi perlanggaran berkesan di antara ion H^+ dengan atom zink dalam Eksperimen II lebih tinggi berbanding dalam Eksperimen I	1

- *The rate of reaction in Experiment II is higher than that of Experiment I*
- *The acid used in Experiment II is a diprotic acid while in Experiment I it is a monoprotic acid*
- *The number of H^+ ions per unit volume in Experiment II is higher than in Experiment I*
- *The frequency of collision between H^+ ions and zinc atoms in Experiment II is higher than in Experiment I*
- *The frequency of effective collision between H^+ ions and zinc atoms in Experiment II is higher than in Experiment I*

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(ii)	- beberapa titis larutan kuprum(II) sulfat ditambah ke dalam campuran Eksperimen III	1
	- larutan kuprum(II) sulfat berfungsi sebagai mangkin untuk tindak balas ini	1
	- mangkin merendahkan tenaga pengaktifan bagi tindak balas ini	1
	- lebih banyak ion H^+ dan atom zink yang berlanggar dapat mencapai tenaga pengaktifan yang lebih rendah dalam Eksperimen III berbanding Eksperimen II	1
	- frekuensi perlanggaran berkesan di antara ion H^+ dan atom zink lebih tinggi dalam Eksperimen III berbanding Eksperimen II	1
	- *a few drops of copper(II) sulphate solution added into the mixture of Experiment III*	
	- *copper(II) sulphate solution acts as a catalyst in this reaction*	
	- *catalyst lowers the activation energy for the reaction*	
	- *more colliding H^+ ions and zinc atoms can achieve the lower activation energy in Experiment III compared to Experiment II*	
	- *frequency of effective collision between H^+ ions and zinc atom is higher in Experiment III compared to Experiment II*	
(iii)	- asid sulfurik dalam Eksperimen II adalah asid diprotik manakala asid hidroklorik dalam Eksperimen I adalah asid monoprotik	1
	- asid sulfurik menghasilkan kepekatan ion H^+ dua kali ganda lebih banyak berbanding asid hidroklorik	1
	- *sulpuric acid in Experiment II is a diprotic acid while hydrochloric acid in Experiment I is a monoprotic acid*	
	- *sulphuric acid produces two times more concentration of H^+ ions compared to hydrochloric acid*	

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Jadual 9.1 menunjukkan bahan tindak balas yang digunakan untuk mengkaji faktor yang mempengaruhi kadar tindak balas.
Table 9.1 shows the reactants used to study the factors that affect the rate of reaction.

Set Eksperimen *Set Experiment*	Bahan tindak balas *Reactants*
I	50 cm³ asid hidroklorik 1.0 mol dm⁻³ + serbuk zink berlebihan *50 cm³ of 1.0 mol dm⁻³ hydrochloric acid + excess of zink powder*
II	50 cm³ asid hidroklorik 1.0 mol dm⁻³ + serbuk zink berlebihan + larutan kuprum (II) sulfat *50 cm³ of 1.0 mol dm⁻³ hydrochloric acid + excess of zink powder + copper (II) sulphate solution*

Jadual 9.1
Table 9.1

Graf 9.2 menunjukkan sebahagian keputusan yang diperolehi dalam eksperimen tersebut.
Graph 9.2 shows some of the results obtained in the experiment.

Isipadu gas hidrogen, cm³
Volume of hydrogen gas, cm³
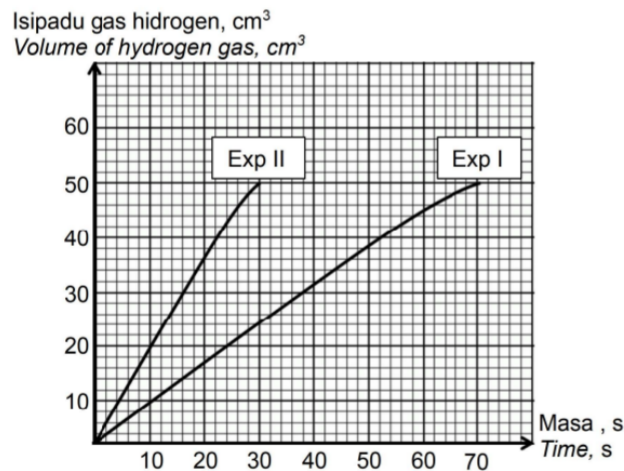
Rajah 9.2
Diagram 9.2

Berdasarkan Jadual 9.1 dan Rajah 9.2
Based on Table 9.1 and Diagram 9.2

(a) (i) Apakah yang dimaksudkan dengan kadar tindak balas?
What is meant by rate of reaction?

[1 markah]
[1 *mark*]

(ii) Dalam sesuatu tindak balas, perlanggaran berkesan antara zarah yang bertindak balas perlu berlaku agar tindak balas berlaku. Nyatakan dua keadaan yang diperlukan untuk memastikan perlanggaran berkesan berlaku.
In a reaction, effective collisions between the reacting particles must occur for the reaction to occur. State two conditions necessary for effective collision to occur.

[2 markah]
[2 *marks*]

(iii) Lukiskan profil tenaga bagi tindak balas tersebut. Tunjukkan tenaga pengaktifan bagi eksperimen Set I dengan label Ea dan tenaga pengaktifan bagi eksperimen Set II dengan label Eb pada profil tenaga yang sama.
Draw the energy profile for the reaction. Show the activation energy for experiment Set I labeled Ea and the activation energy for experiment Set II labeled Eb on the same energy profile.

[3 markah]
[3 *marks*]

(a).	Perubahan isipadu gas oksigen per unit masa	1
	Perlanggaran pada orientasi yang betul	1
	Mencapai tenaga pengaktifan	1
	Paksi aras tenaga berlabel dan aras tenaga yang betul	1
	Tenaga pengaktifan Ea dan Eb 	2

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(b) (i) Hitungkan kadar tindak balas purata bagi eksperimen Set I dan Set II.
Calculate the average rate of reaction for experiment Set I and Set II

[2 markah]
[2 *marks*]

(ii) Bandingkan kadar tindak balas dalam eksperimen Set I dengan Set II.
Terangkan jawapan anda berdasarkan teori perlanggaran.
Compare the reaction rates in Set I and Set II experiments. Explain your answer based on collision theory.

[5 markah]
[5 *marks*]

(c) Eksperimen Set I di ulang dengan menggantikan asid hidroklorik dengan asid sulfurik pada isipadu dan kepekatan yang sama.
Experiment Set I was repeated by replacing hydrochloric acid with sulphuric acid at the same volume and concentration.

(i) Tuliskan persamaan kimia bagi tindak balas di (c) dan hitungkan isipadu gas hidrogen yang mungkin terbebas dalam tindak balas tersebut.
[Isipadu molar gas pada keadaan bilik = 24 dm^3 mol^{-1}]
Write the chemical equation for the reaction in (c) and calculate the volume of hydrogen gas that may be liberated in the reaction.
[*Molar volume of gas at room temperature* = 24 dm^3 mol^{-1}]

[5 markah]
[5 *marks*]

(ii) Bandingkan kadar tindak balas antara eksperimen dalam (c) dengan eksperimen Set I. Terangkan jawapan anda.
Compare the rate of reaction between the experiment in (c) with the Set I experiment. Explain your answer.

[2 markah]
[2 *marks*]

(b)	Set I : 0.714 cm^3 s^{-1}	1
	Set II : 1.67 cm^3 s^{-1}	1
	Kadar tindak balas dalam Set II lebih tinggi daripada Set I	1
	Dalam Set II menggunakan mangkin kuprum (II) sulfat, Set I tiada	1
	Kehadiran mengkin dalam Set II menyediakan laluan alternatif dengan tenaga pengaktifan yang lebih rendah	1
	Lebih banyak zarah ion H^+ dan Zn dapat mencapai tenaga pengaktifan dalam Set II berbanding Set I	1
	Frekuensi perlanggaran berkesan antara ion H^+ dan Zn dalam Set II lebih tinggi berbanding Set I	1

(c)	Zn + H_2SO_4 → $ZnSO_4$ + H_2	2
	Mol H_2SO_4 :0.05 mol	1
	0.05 mol H_2	1
	Isipadu H_2 : 1.2 dm^{-3}	1
	Kadar tindak balas eksperimen C lebih tinggi	1
	Jumlah ion H per isipadu dalam asid sulfurik lebih tinggi, kadar tindak balas lebih tinggi	1

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(a) Jadual 9 menunjukkan tiga set eksperimen yang dijalankan untuk mengkaji faktor-faktor yang mempengaruhi kadar tindak balas antara zink dengan asid hidroklorik.

Table 9 shows three sets of experiment carried out to investigate the factors that affect the rate of reaction between zinc and hydrochloric acid.

Eksperimen Experiment	Bahan tindak balas Reactants
I	Serbuk zink berlebihan + 25 cm^3 asid hidroklorik 0.5 mol dm^{-3} *Excess zinc powder + 25 cm^3 of 0.5 mol dm^{-3} hydrochloric acid*
II	Serbuk zink berlebihan + 25 cm^3 asid hidroklorik 1.0 mol dm^{-3} *Excess zinc powder + 25 cm^3 of 1.0 mol dm^{-3} hydrochloric acid*
III	Serbuk zink berlebihan + 25 cm^3 asid hidroklorik 1.0 mol dm^{-3} + 10 cm^3 larutan kuprum(II) sulfat 1.0 mol dm^{-3} *Excess zinc powder + 25 cm^3 of 1.0 mol dm^{-3} hydrochloric acid + 10 cm^3 1.0 mol dm^{-3} copper(II) sulphate solution*

Jadual 9
Table 9

(i) Berdasarkan eksperimen tersebut, nyatakan maksud kadar tindak balas.

[1 markah]

Based on the experiment, state the meaning of rate of reaction.

[1 mark]

(ii) Tuliskan persamaan kimia bagi tindak balas yang berlaku antara zink dan asid hidroklorik dalam Eksperimen I. Hitung isi padu gas yang dibebaskan bagi eksperimen tersebut. Eksperimen ini mengambil masa 2 minit untuk melengkapkan tindak balas. Hitung kadar tindak balas purata dengan unit cm^3 s^{-1} bagi tindak balas ini.
[1 mol gas menempati isi padu 24.0 dm^3 pada keadaan bilik]

[6 markah]

Write the chemical equation for the reaction that occurred between zinc and hydrochloric acid in Experiment I. Calculate the volume of gas released for the experiment. The experiment took 2 minutes to complete the reaction. Calculate the average rate of reaction in cm^3 s^{-1} for this reaction.
[1 mol of gas occupies the volume of 24.0 dm^3 at room condition]

[6 marks]

(iii) Pada paksi yang sama, lakarkan graf isi padu gas melawan masa bagi Eksperimen I, Eksperimen II dan Eksperimen III.

[4 markah]

On the same axis, sketch the graph of gas volume against time for Experiment I, II and III.

[4 marks]

(iv) Bandingkan kadar tindak balas antara Eksperimen II dan Eksperimen III. Jelaskan jawapan anda berdasarkan Teori Perlanggaran.

[6 markah]

Compare the rate of reaction between Experiment II and III. Explain your answer based on Collision Theory.

[6 marks]

(b) Tablet antasid digunakan untuk merawat gastrik. Doktor menasihatkan pesakit mengunyah tetapi bukan menelan. Berikan alasan.

[3 markah]

Antasid tablets are used to treat gastric. Doctors advise patients to chew instead of swallowing. Give the reason.

[3 marks]

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10 (a) Maklumat berikut menunjukkan dua situasi untuk melarutkan garam di dalam air.
The following information shows two situations to dissolve salt in water.

Situasi I	:	Garam halus lebih mudah larut di dalam air panas berbanding dengan air sejuk.
Situation I	:	*Fine salt is easier to dissolve in hot water compared to cold water.*
Situasi II	:	Garam halus lebih mudah larut berbanding garam kasar di dalam air sejuk.
Situation II	:	*Fine salt is easier to dissolve compared to coarse salt in cold water.*

Berdasarkan situasi tersebut, nyatakan dua faktor yang terlibat. Dengan memilih salah satu situasi, jelaskan bagaimana faktor tersebut mempengaruhi keterlarutan garam.

Based on the situations, state the two factors involved. By choosing one of the situations, explain how the factor affects the solubility of salt.

[4 markah / marks]

(b) Jadual 7 menunjukkan tiga set eksperimen yang dijalankan untuk mengkaji kadar tindak balas antara zink dengan asid nitrik.
Table 7 shows three sets of experiment that are carried out to study the rate of reaction between zinc and nitric acid.

Set	Bahan tindak balas *Reactants*	Suhu (°C) *Temperature (°C)*
I	9 g serbuk zink + 25 cm³ asid nitrik 0.2 mol dm⁻³ *9 g zinc powder + 25 cm³ of 0.2 mol dm⁻³ nitric acid*	30
II	9 g serbuk zink + 25 cm³ asid nitrik 0.2 mol dm⁻³ *9 g zinc powder + 25 cm³ of 0.2 mol dm⁻³ nitric acid*	50
III	9 g serbuk zink + 25 cm³ asid nitrik 0.2 mol dm⁻³ + larutan kuprum(II) sulfat *9 g zinc powder + 25 cm³ of 0.2 mol dm⁻³ nitric acid + copper(II) sulphate solution*	30

Jadual / *Table* 7

(i) Tuliskan persamaan kimia bagi tindak balas antara zink dan asid nitrik. Hitung isi padu maksimum gas yang terbebas dalam Set I.
[Jisim atom relatif : Zn = 65; Isi padu molar gas = 24 dm³ mol⁻¹ pada keadaan bilik]
Write the chemical equation for the reaction between zinc and nitric acid. Calculate the maximum volume of gas produced in Set I.
[Relative atomic mass : Zn = 65; Molar volume of gas = 24 dm³ mol⁻¹ at room condition]

[6 markah / marks]

(a)	P1: Suhu // *Temperature*	1
	P2: Saiz // *Size*	1
	<u>Faktor : Suhu // *Factor: Temperature*</u>	
	P3: Suhu air panas adalah lebih tinggi daripada air sejuk. // *Temperature of hot water is higher than cold water.*	1
	P4: Tenaga kinetik molekul air dalam air panas adalah lebih tinggi daripada dalam air sejuk. // *Kinetic energy of water molecules in hot water is higher than in cold water.*	1
	ATAU / OR	
	<u>Faktor : Saiz // *Factor: Size*</u>	
	P3: Saiz garam halus adalah lebih kecil daripada garam kasar. // *Size of fine salt is smaller than coarse salt.*	1
	P4: Jumlah luas permukaan garam halus yang terdedah kepada air adalah lebih besar. // *Total surface area of fine salt that exposed to water is larger.*	1

(b)	(i)	P1: Formula bahan dan hasil tindak balas yang betul. // *Correct formulae of reactants and products.*	1
		P2: Persamaan seimbang // *Balanced equation.*	1
		$Zn + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2$	
		P3: Bilangan mol Zn // *Number of moles of Zn* $= \frac{9}{65} = 0.14 \ mol$	1
		P4: Bilangan mol HNO₃ // *Number of moles of* HNO₃ $= \frac{25 \times 0.2}{1000} = 0.005 \ mol$	1
		P5: Nisbah mol // *Ratio of moles* 2 mol HNO₃ menghasilkan 1 mol gas H₂ 0.005 mol HNO₃ menghasilkan 0.0025 mol gas H₂ // *2 moles of* HNO₃ *produced 1 mole of* H₂ *gas* *0.05 mole of* HNO₃ *produced 0.0025 mole of* H₂ *gas*	1
		P6: Isi padu gas H₂ // *Volume of* H₂ *gas* $= 0.0025 \times 24 \ dm^3$ // 0.06 dm³ // 60 cm³	1

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(b) Jadual 7 menunjukkan tiga set eksperimen yang dijalankan untuk mengkaji kadar tindak balas antara zink dengan asid nitrik.

Table 7 shows three sets of experiment that are carried out to study the rate of reaction between zinc and nitric acid.

Set	Bahan tindak balas *Reactants*	Suhu (°C) *Temperature (°C)*
I	9 g serbuk zink + 25 cm³ asid nitrik 0.2 mol dm⁻³ 9 g *zinc powder* + 25 cm³ *of* 0.2 mol dm⁻³ *nitric acid*	30
II	9 g serbuk zink + 25 cm³ asid nitrik 0.2 mol dm⁻³ 9 g *zinc powder* + 25 cm³ *of* 0.2 mol dm⁻³ *nitric acid*	50
III	9 g serbuk zink + 25 cm³ asid nitrik 0.2 mol dm⁻³ + larutan kuprum(II) sulfat 9 g *zinc powder* + 25 cm³ *of* 0.2 mol dm⁻³ *nitric acid* + *copper*(II) *sulphate solution*	30

Jadual / *Table* 7

(ii) Bandingkan kadar tindak balas bagi:
Compare the rate of reaction for:

- Set I dan Set II
  Set I and Set II
- Set I dan Set III
  Set I and Set III

Terangkan jawapan anda berdasarkan Teori Pelanggaran.
Explain your answer based on Collision Theory.

[10 markah / marks]

(ii) | Set I dan Set II / *Set I and Set II* | |
|---|---|
| P1: Kadar tindak balas Set II lebih tinggi daripada Set I. //
Rate of reaction of Set II is higher than Set I.
r : lebih cepat / *faster* | 1 |
| P2: Suhu dalam Set II lebih tinggi daripada Set I. //
The temperature in Set II is higher than Set I.
r : suhu Set II ialah 50 °C, manakala suhu Set I ialah 30 °C
temperature in Set II is 50 °C, while temperature in Set I is 30 °C | 1 |
| P3: Tenaga kinetik dalam Set II lebih tinggi daripada Set I. //
Kinetic energy in Set II is higher than Set I. | 1 |
| P4: Frekuensi perlanggaran antara atom **zink** dengan **ion hidrogen** dalam Set II lebih tinggi daripada Set I. //
*Frequency of collision between **zinc** atoms and **hydrogen ions** in Set II is higher than Set I.*
r : antara zarah-zarah / *between particles*
*jawapan mesti spesifik, zarah apa yang berlanggar | 1 |
| P5: Frekuensi perlanggaran berkesan antara zarah dalam Set II lebih tinggi daripada Set I. //
Frequency of effective collision between particles in Set II is higher than Set I. | 1 |
| Set I dan Set III / *Set I and Set III* | |
| P6: Kadar tindak balas Set III lebih tinggi daripada Set I. //
Rate of reaction of Set III is higher than Set I.
r : lebih cepat / *faster* | 1 |
| P7: Terdapat kehadiran mangkin dalam Set III. //
There is a catalyst presence in Set III. | 1 |
| P8: Mangkin merendahkan tenaga pengaktifan tindak balas. //
Catalyst lowers the activation energy of the reaction. | 1 |
| P9: Lebih banyak zarah yang berlanggar dapat mencapai tenaga pengaktifan. //
More colliding particles can achieve the activation energy. | 1 |
| P10: Frekuensi perlanggaran berkesan antara atom zink dengan ion hidrogen dalam Set III lebih tinggi daripada Set I. //
Frequency of effective collision between zinc atoms and hydrogen ions in Set III is higher than Set I. | 1 |

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Elisa menjalankan satu eksperimen untuk mengkaji kadar penguraian hidrogen peroksida, H_2O_2 di dalam makmal. Elisa menggunakan satu spatula serbuk hitam sebagai mangkin bagi eksperimen tersebut. Elisa mendapati gas yang terkumpul dapat menyalakan kayu uji berbara. Elisa merekodkan gas terkumpul seperti Jadual 3.

Elisa conducted an experiment to study the rate of decomposition of hydrogen peroxide, H_2O_2 in the laboratory. Elisa used a spatula of black powder as a catalyst for the experiment. Elisa found that the accumulated gas could ignite a glowing wooden splinter. Elisa records the accumulated gas as in Table 3.

Masa Time (s)	0	30	60	90	120	150	180	210	240	270	300	330	360	360
Bacaan buret Burette reading (cm^3)	50	36	28	22	17	13	9	7	5	3	2	1	0	0
Isipadu gas Volume of gas (cm^3)	0													

Jadual 3
Table 3

(a) (i) Namakan gas yang terbentuk dan kemungkinan mangkin yang digunakan.
Name gas produced and probably catalyst used.

[2 markah]
[2 marks]

(ii) Lengkapkan Jadual 3 dengan mengisi ruang isipadu gas. Plot graf isipadu gas melawan masa yang diambil dan hitung kadar tindak balas purata :
- keseluruhan tindak balas.
- dalam minit ke lima.

Complete Table 3 by filling the space volume of gas. Plot a graph of the volume of gas against time taken and calculate the average rate of reaction :
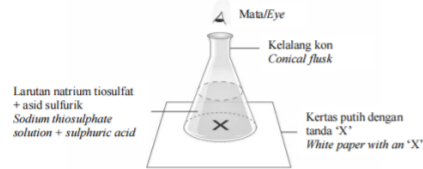- *overall reaction.*
- *in fifth minute.*

[8 markah]
[8 marks]

(a)	(i)	Contoh jawapan : *Sample answer :*	
		Gas oksigen *Oxygen gas*	1
		Contoh jawapan : *Sample answer :* Mangan(IV) oksida// Kuprum(II) oksida// Serbuk besi// Serbuk platinum *Manganese(IV) oxide// Copper(II) oxide// Iron powder// Platinum powder* (mana-mana satu/ *any one*)	1

(ii) Contoh jawapan : *Sample answer :*

0.0 0	14. 00	22. 00	28. 00	33. 00	37. 00	41. 00	43. 00	45. 00	47. 00	48. 00	49. 00	50. 00	50. 00

Semua betul/*All correct* — 1
dengan 2 titik perpuluhan/ *with 2 decimal place* — 1

Memplot graf berdasarkan kriteria ini :
Ploting graph according to these criteria :

❖ Paksi berlabel
   Labelled axis — 1
❖ Skala seragam
   Uniform scale — 1
❖ Pindahan titik yang betul
   Transfer correct dot — 1
❖ Bentuk graf dan licin
   Shape and smooth graph — 1

Kadar tindak balas purata keseluruhan :
Overall average rate of reaction :
$$\frac{50 \ cm^3}{360 \ s} = 0.1389 \ cm^3 \ s^{-1}$$ — 1

*Terima jawapan dalam dua titik perpuluhan
 Accept the answer in two decimal place
*Terima jawapan sekiranya menggunakan minit
 Accept the answer if use minute

Kadar tindak balas purata dalam minit kelima :
Average rate of reaction in 5th minute :
$$\frac{(48 - 45) \ cm^3}{60 \ s} = 0.05 \ cm^3 \ s^{-1}$$ — 1

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(b) (i) Ekhwan menjalankan dua aktiviti kadar tindak balas untuk mengkaji faktor suhu.
Berikut merupakan dapatan setelah dua aktiviti tersebut:
Ekhwan carried out two activities regarding rates of reaction to study the factor of temperature. Here are the findings after the two activities :
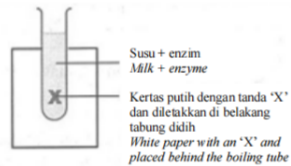
Situasi A
Situation A

Mata/*Eye*

Kelalang kon
Conical flask

Larutan natrium tiosulfat
+ asid sulfurik
Sodium thiosulphate solution + sulphuric acid

Kertas putih dengan tanda 'X'
White paper with an 'X'

Keputusan eksperimen :
Result of experiment :

Suhu *Temperature* (°C)	15.0	25.0	35.0	45.0	55.0	65.0
Masa untuk tanda 'X' tidak kelihatan *Time taken for mark 'X' invisible* (s)	270.0	100.0	50.0	27.0	10.0	7.0

Situasi B
Situation B

Susu + enzim
Milk + enzyme

Kertas putih dengan tanda 'X' dan diletakkan di belakang tabung didih
White paper with an 'X' and placed behind the boiling tube

Keputusan eksperimen :
Result of experiment :

Suhu *Temperature* (°C)	15.0	25.0	35.0	45.0	55.0	65.0
Masa untuk tanda 'X' kelihatan *Time taken for mark 'X' visible* (s)	360.0	240.0	120.0	180.0	300.0	500.0

Terangkan perbezaan yang berlaku pada situasi A dan situasi B berdasarkan teori perlanggaran dan pengetahuan kimia anda.
Explain the difference that occurs at situation A and situation B based on collision's theory and your chemistry knowledge.

[10 *markah*]
[10 *marks*]

(b) Contoh jawapan :
Sample answer :

Situasi A/ *Situation* A
- Kadar tindak balas meningkat dengan penambahan suhu.
  The reaction rate increases with increasing temperature. — 1
- Tenaga kinetik zarah ion H^+ meningkat.
  The kinetic energy of the H^+ ion particles increases. — 1
- Frekuensi pelanggaran antara ion H^+ dan ion $S_2O_3^{2-}$ meningkat.
  The frequency of collisions between H^+ ions and $S_2O_3^{2-}$ ions increases. — 1
- Frekuensi pelanggaran berkesan meningkat.
  The frequency of effective collision increases. — 1

Situasi B/ *Situation* B
- Kadar tindak balas meningkat dan kemudian menurun dengan penambahan suhu.
  The reaction rate increases and then decreases with increasing temperature. — 1
- Kadar tindak balas meningkat kerana :
  The reaction rate increased because :
  (i) kehadiran mangkin/ *presence of catalyst*. — 1
  (ii) kenaikan suhu/ *temperature increase*. — 1

- Pada peringkat akhir, kadar tindak balas menurun kerana :
  In the final stage, the reaction rate decreases because :
  (i) enzim berfungsi optimum pada suhu 37°C (suhu badan).
      enzymes work optimally at a temperature of 37°C (body temperature). — 1
  (ii) enzim menjadi terdenaturasi pada suhu tinggi dan hilang kebolehan untuk mempercepat kadar tindak balas.
       enzymes become denatured at high temperature and lost the ability to speed up the reaction rate. — 1 1

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(a) An experiment is carried out to determine the rate of decomposition of hydrogen peroxide, H_2O_2 to water and oxygen with the presence of substance X as a catalyst.
The results of the experiment is recorded in Table below
Suatu eksperimen dijalankan bagi menentukan kadar penguraian hydrogen peroksida, H_2O_2 kepada air dan oksigen dengan kehadiran bahan X sebagai mangkin. Keputusan bagi eksperimen ini direkodkan seperti dalam Jadual di bawah.

Time (s) *Masa (s)*	0	60	120	180	240	300	360	420
Volume of oxygen gas (cm³) *Isipadu gas oksigen (cm³)*	0.00	22.00	33.00	40.50	45.00	48.00	50.00	50.00

Based on Table above,
Berdasarkan Jadual di atas,

(i) State the meaning of catalyst and suggest the name of substance X
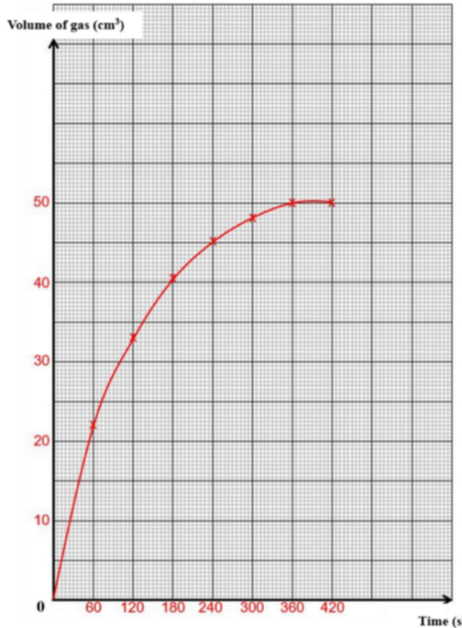*Nyatakan maksud mangkin dan cadangkan nama bahan X.*

[2 marks]

(ii) Plot a graph of the volume of oxygen gas against the time taken.
Calculate the average rate of reaction
Plotkan graf isipadu gas oksigen melawan masa yang diambil.
Hitungkan kadar tindak balas purata

- In second minute
  Dalam minit kedua
- In sixth minute
  Dalam minit ke enam

Compare the rate of reaction in the second and sixth minutes.
Explain your answer.
Bandingkan kadar tindak balas dalam minit kedua dan keenam.
Terangkan jawapan anda.

[8 marks]

(a)	1. Catalysts are chemical substances that alter the rate of chemical reactions without undergoing any chemical changes at the end of the reaction	1
	2. Substance X is manganese (IV) oxide	1

(b)(i)

	1
1. Correct axis with label	1
2. Uniform scale	1
3. Points are transfer correctly	1
4. Correct pattern and smooth graph	
5. Average ROR in the second minutes= $\frac{33-22}{120-60}$ = 0.1833 cm³s⁻¹	1
6. Average ROR in the sixth minutes= $\frac{50-48}{360-300}$ = 0.0333 cm³s⁻¹	1
7. The rate of reaction in the second minutes is higher than in sixth minutes	1
8. The concentration of hydrogen peroxide decreases with time	1

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(b) Three sets of experiments were conducted to study the rate of hydrogen gas release in the reaction between strong acid and zinc. Table below shows information about the experiment.

Tiga set eksperimen dijalankan untuk mengkaji kadar pembebasan gas hydrogen dalam tindak balas antara asid kuat dengan zink. Jadual di bawah menunjukkan maklumat tentang eksperimen tersebut.

Experiment *Eksperimen*	Reactants *Bahan tindak balas*	Temperature (oC) *Suhu (oC)*
I	50 cm^3 of 1.0 mol dm^{-3} monoprotic acid X + zinc powder *50 cm^3 asid monoprotik X 1.0 mol dm^3 + serbuk zink*	60
II	50 cm^3 of 1.0 mol dm^{-3} monoprotic acid X + zinc powder *50 cm^3 asid monoprotik X 1.0 mol dm^3 + serbuk zink*	30
III	50 cm^3 of 1.0 mol dm^{-3} diprotic acid Y + zinc powder *50 cm^3 asid diprotik Y 1.0 mol dm^{-3} + serbuk zink*	30

Compare the rate of reaction between
Bandingkan kadar tindak balas antara

- Set I and Set ll
- Set ll and Set lll

Explain your answers using collision theory
Terangkan jawapan anda menggunakan teori perlanggaran.

[10 marks]

(b)		1
	Set I and Set II	
	1. The rate of reaction in Set I is higher than in Set II	
	2. The temperature of the reactants in Set I is higher than in Set II	1
	3. The kinetic energy of the reacting particles in Set I is higher than in Set II// The reacting particles in Set I move faster and collide more often than that in Set II	
	4. More colliding particles in Set I have enough energy to overcome the activation energy than that in Set II// Frequency of collision between zinc atom and hydrogen ions in Set I is higher than in Set II	1 1 1 1
	5. Frequency of effective collision between zinc atom and hydrogen ions in Set I is higher than in Set II	1
		1
	Set II and Set III	1
	6. The rate of reaction in set III is higher than in set II	1
	7. The concentration of hydrogen ions is set III is higher than in set II	
	8. The number of hydrogen ions per unit volume in set III is higher than in set II	
	9. Frequency of collision between zinc atom and hydrogen ions in Set III is higher than in Set II	
	10. Frequency of effective collision between zinc atom and hydrogen ions in Set III is higher than in Set II	

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(b) Jadual 6 menunjukkan tiga eksperimen yang dijalankan untuk mengkaji faktor-faktor yang mempengaruhi kadar tindak balas.

Table 6 shows three experiments that are carried out to investigate the factors affecting rate of reaction.

Eksperimen *Experiment*	Bahan tindak balas *Reactants*	Suhu campuran (°C) *Temperature of the mixture (°C)*
Set I *Set I*	Zink berlebihan + 50 cm³ asid hidroklorik 0.5 mol dm⁻³ *Excess zinc +* *50 cm³ of 0.5 mol dm⁻³ hydrochloric acid*	30
Set II *Set II*	Zink berlebihan + 50 cm³ asid sulfurik 0.5 mol dm⁻³ *Excess zinc +* *50 cm³ of 0.5 mol dm⁻³ sulphuric acid*	30
Set III *Set III*	Zink berlebihan + 50 cm³ asid sulfurik 0.5 mol dm⁻³ *Excess zinc +* *50 cm³ of 0.5 mol dm⁻³ sulphuric acid*	50

Jadual 6
Table 6

Berdasarkan maklumat dalam Jadual 6, banding kadar tindak balas antara
Based on the information in Table 6, compare the rate of reaction between

(i)   Set I dan Set II
      Set I and Set II

(ii) Set II dan Set III
      Set II and Set III

Dengan menggunakan teori perlanggaran, terangkan jawapan anda.
By using the collision theory, explain your answers.

[10 markah]
[10 marks]

(b) (i) Set I dan Set II

- Kadar tindak balas Set II lebih tinggi berbanding kadar tindak balas Set I.
- Dalam Set I menggunakan asid monoprotik manakala Set II menggunakan asid diprotik
- Bilangan ion hidrogen perunit isi padu dalam Set II lebih tinggi daripada Set I
- Frekuensi perlanggaran antara H⁺ ion dan atom Zn lebih tinggi di Set II daripada Set I.
- Frekuensi perlanggaran berkesan antara zarah lebih tinggi di Set II daripada Set I

Set I and Set II

- *The rate of reaction in Set II is higher than in Set I.*
- *In Set I monoprotic acid is used while in Set II diprotic acid is used.*
- *The number of hydrogen ion per unit volume is higher in Set II than Set I*
- *The frequency of collisions between H⁺ ion and Zn atom is higher in Set II than Set I*
- *Frequency of effective collisions between the particles is higher in Set II than Set I*

(ii) Set II dan Set III

- Kadar tindak balas Set III lebih tinggi berbanding kadar tindak balas Set II.
- Suhu HCl dalam Set III lebih tinggi daripada Set II
- Tenaga kinetik zarah dalam Set III lebih tinggi daripada Set II
- Frekuensi perlanggaran antara H⁺ ion dan atom Zn lebih tinggi di Set III daripada Set II
- Frekuensi perlanggaran berkesan antara zarah lebih tinggi di Set III daripada Set II

Set II and Set III

- *The rate of reaction in Set III is higher than in Set II.*
- *The temperature of acid is higher in Set III than Set II*
- *The kinetic energy of particles in Set III is higher than Set II*
- *The frequency of collisions between H⁺ ion and Zn atom is higher in Set III than Set II*
- *Frequency of effective collisions between the particles is higher in Set III than Set II*

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(c) Tulis persamaan kimia yang seimbang bagi tindak balas antara asid hidroklorik dengan zink berlebihan.

Hitung isi padu maksimum gas hidrogen yang terhasil pada keadaan bilik dalam Set I.
[1 mol gas menempati 24 dm³ mol⁻¹ pada keadaan bilik]

Write a balanced chemical equation for the reaction between hydrochloric acid and excess zinc.

Calculate the maximum volume of hydrogen gas produced in room condition in Set I.
[1 mole of gas occupied 24 dm³ mol⁻¹ at room condition]

[5 markah]
[5 marks]

(c)	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$	2
	Bilangan mol HCl;	
	$n = MV / 1000$	
	$=[(50)(1.0)] / 1000$	1
	$= 0.05$ mol	
	(Nota: asid hidroklorik sebagai faktor pengehad)	
	Dari persamaan,	
	2 mol HCl $\rightarrow 1$ mol H_2	
	Maka,	1
	0.05 mol HCl $\rightarrow 0.025$ mol H_2	
	Isi padu maksimum gas;	
	0.025 mol x 24dm³	
	$= 0.6$ dm³	1

Jadual 6 menunjukkan maklumat bagi tiga set eksperimen untuk menyiasat faktor-faktor yang mempengaruhi kadar tindak balas antara zink berlebihan dengan 50 cm³ asid hidroklorik 1.0 mol dm⁻³.

Table 6 shows the information for three sets of experiments to investigate factors affecting the rate of reaction between excess zinc and 50 cm³ of 1.0 mol dm⁻³ hydrochloric acid.

Set *Set*	Bahan tindak balas *Reactants*	Suhu campuran (°C) *Temperature of the mixture (°C)*	Masa yang diambil untuk mengumpul 30 cm³ gas hidrogen (s) *Time taken to collect 30 cm³ hydrogen gas (s)*
I	Zink berlebihan + 50 cm³ asid hidroklorik 1.0 mol dm⁻³ *Excess zinc + 50 cm³ of 1.0 mol dm⁻³ hydrochloric acid*	40	56
II	Zink berlebihan + 50 cm³ asid hidroklorik 1.0 mol dm⁻³ + larutan X *Excess zinc + 50 cm³ of 1.0 mol dm⁻³ hydrochloric acid + solution X*	40	42
III	Zink berlebihan + 50 cm³ asid hidroklorik 1.0 mol dm⁻³ *Excess zinc + 50 cm³ of 1.0 mol dm⁻³ hydrochloric acid*	50	35

Jadual 6
Table 6

Set Pecutan Kimia 2024
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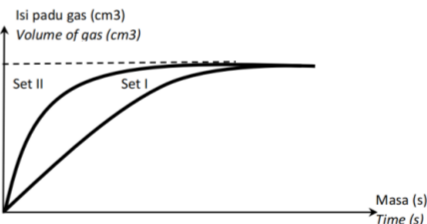
Berdasarkan Jadual 6, jawab soalan-soalan berikut.
Based on Table 6, answer the following questions.

(a) **(i)** **Apakah maksud kadar tindak balas?**
What is the meaning of rate of reaction?

[1 markah]
[1 mark]

(ii) **Namakan larutan X dan nyatakan fungsinya.**
Name the solution X and its function.

[2 markah]
[2 marks]

(iii) **Tuliskan persamaan kimia bagi tindak balas antara zink berlebihan dan asid hidroklorik.**
Write the chemical equation for the reaction between excess zinc and hydrochloric acid.

[2 markah]
[2 marks]

(b) **Lakarkan graf isi padu gas melawan masa bagi Set I dan Set II.**
Sketch the graphs of volume of gas against time for Set I and Set II.

[3 markah]
[3 marks]

(c) **Hitung kadar tindak balas purata yang dihasilkan dalam**
Calculate the average rate of reaction produced in

(i) **Set I**

(ii) **Set II**

[2 markah]
[2 marks]

(a)	(i)	Kadar tindak balas ialah isipadu gas hidrogen terbebas per unit masa	
		The volume of hydrogen gas released per unit time	1
	(ii)	Kuprum (II) sulfat	
		Copper (II) sulphate	1
		sebagai mangkin // mempercepatkan tindak balas// meningkatkan kadar tindak balas	1
		act as catalyst// faster the reaction// increase the rate of reaction	
		$Zn + 2HCl \rightarrow ZnCl_2 + H_2$	2
	(iii)	*Dapat menulis formula kimia yang betul*	
		dapat seimbangkan persamaan	

(b)	(i)	

- Melukis paksi X dan paksi Y dan label unit

  Draw x axis and y axis with labelled unit

- Melukis dan melabel lengkung graf set I — 1

  Draw and label the curve of set I

- Melukis dan melabel lengkung graf set II — 1

  Draw and label the curve of set II

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(d) Berdasarkan maklumat dalam Jadual 6, banding kadar tindak balas antara
Based on the information in Table 6, compare the rate of reaction between

(i) Set I dan Set II
Set I and Set II

(ii) Set I dan Set III
Set I and Set III

Dengan menggunakan teori perlanggaran, terangkan jawapan anda.
By using the collision theory, explain your answers.

[10 markah]
[10 marks]

(c)	(i)	Set I	
		Kadar tindak balas/ rate of reaction	
		$= \dfrac{\text{Isi padu gas (cm}^3)}{\text{Masa (s)}}$	1
		$= \dfrac{30 \text{ cm}^3}{56\text{s}}$	
		$=0.54$ cm^3/s	
		Set II	
		Kadar tindak balas/rate of reaction	
		$= \dfrac{\text{Isi padu gas (cm}^3)}{\text{Masa (s)}}$	1
		$= \dfrac{30 \text{ cm}^3}{42\text{s}}$	
		$=0.71$ cm^3/s	

(d)	i	*Set I dan set II*	
		• Kadar tindak balas set II lebih tinggi berbanding kadar tindak balas set I.	
		• Dalam set II, mangkin digunakan/ kuprum (II) sulfat digunakan	
		• Mangkin merendahkan tenaga pengaktifan dengan menyediakan laluan alternatif	
		• Lebih banyak zarah bahan tindak balas/ H$^+$ ion dan atom Zn boleh mencapai tenaga pengaktifan dalam Set II daripada set I.	
		• Frekuensi perlanggaran berkesan antara zarah lebih tinggi di Set II daripada set I	5
		Set I and Set II	
		• *The rate of reaction in set II is higher than in set I.*	
		• *In set II, catalyst is being used / copper (II) sulphate being used*	
		• *This lowers the activation energy by providing alternative pathway*	

	ii	• *More reactant particles/ Zn atom and H$^+$ ion can achieve activation in Set II than Set I*	
		• *Frequency of effective collisions between the particles is higher in Set II than Set I*	
		Set I dan set III	
		• Kadar tindak balas set III lebih tinggi berbanding kadar tindak balas set I.	
		• Suhu HCl dalam Set III lebih tinggi dari Set I	
		• Tenaga kinetik zarah dalam set III lebih tinggi dari set I	
		• Frekuensi perlanggaran antara H$^+$ ion dan atom Zn lebih tinggi di Set III dari Set I	
		• Frekuensi perlanggaran berkesan antara zarah lebih tinggi di Set III dari set I	5
		Set I dan set III	
		• *The rate of reaction in set III is higher than in set I.*	
		• *The temperature of acid is higher in set III than Set I*	
		• *The kinetic energy of particles in Set III is higher than Set I*	
		• *The frequency of collisions between H$^+$ ion and Zn atom is higher in Set III than Set I*	
		• *Frequency of effective collisions between the particles is higher in Set III than Set I*	