

THE PERIODIC TABLE OF ELEMENTS

Group →

Period ↓

Symbol of the element
Proton number
Relative atomic mass
Name of the element

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen 1	2 He Helium 4																
3 Li Lithium 7	4 Be Beryllium 9											5 B Boron 11	6 C Carbon 12	7 N Nitrogen 14	8 O Oxygen 16	9 F Fluorine 19	10 Ne Neon 20
11 Na Sodium 23	12 Mg Magnesium 24											13 Al Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulphur 32	17 Cl Chlorine 35.5	18 Ar Argon 40
19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 59	29 Cu Copper 64	30 Zn Zinc 65	31 Ga Gallium 70	32 Ge Germanium 73	33 As Arsenic 75	34 Se Selenium 79	35 Br Bromine 80	36 Kr Krypton 84
37 Rb Rubidium 85.5	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 91	41 Nb Niobium 93	42 Mo Molybdenum 96	43 Tc Technetium 98	44 Ru Ruthenium 101	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 108	48 Cd Cadmium 112	49 In Indium 115	50 Sn Tin 119	51 Sb Antimony 122	52 Te Tellurium 128	53 I Iodine 127	54 Xe Xenon 131
55 Cs Caesium 133	56 Ba Barium 137	57-71 Lanthanides	72 Hf Hafnium 178.5	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 186	76 Os Osmium 190	77 Ir Iridium 192	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 201	81 Tl Thallium 204	82 Pb Lead 207	83 Bi Bismuth 209	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89-103 Actinides	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson

Lanthanides series

57 La Lanthanum 139	58 Ce Cerium 140	59 Pr Praseodymium 141	60 Nd Neodymium 144	61 Pm Promethium	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 162.5	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
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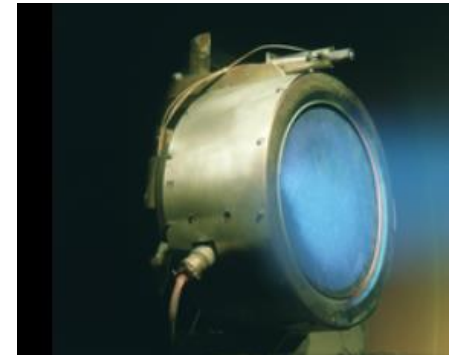
Actinides series

89 Ac Actinium	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium
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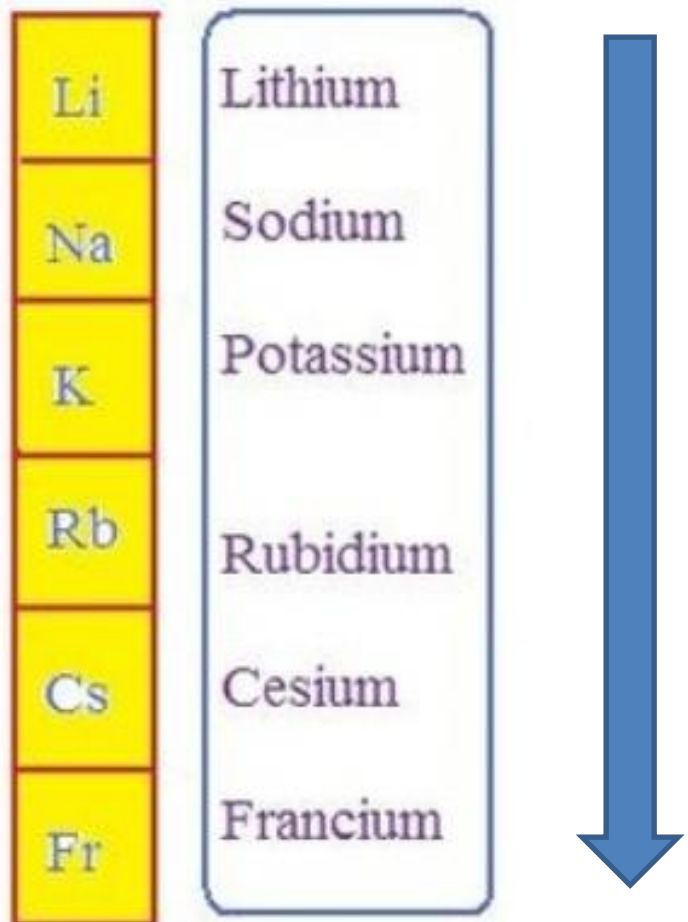




Helium 2 He
Neon 10 Ne
Argon 18 Ar
Krypton 36 Kr
Xenon 54 Xe
Radon 86 Rn



Brought to you by:



Li	Lithium
Na	Sodium
K	Potassium
Rb	Rubidium
Cs	Cesium
Fr	Francium

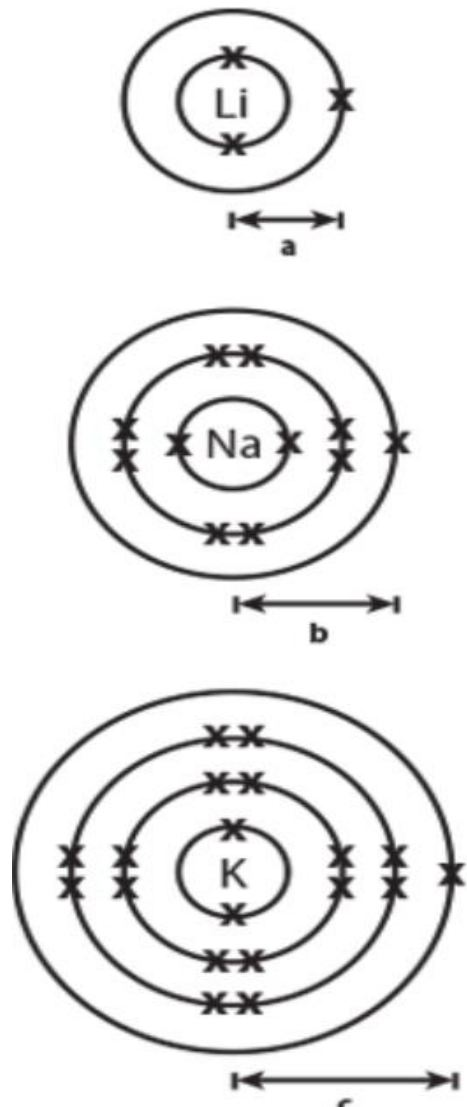
Important trends **down the group** with increase in atomic number...

The **melting point and boiling point** generally **decrease**

The **atoms get bigger**, as more **electron shells** are added

Generally the **density increases** although the atom gets bigger; there is greater

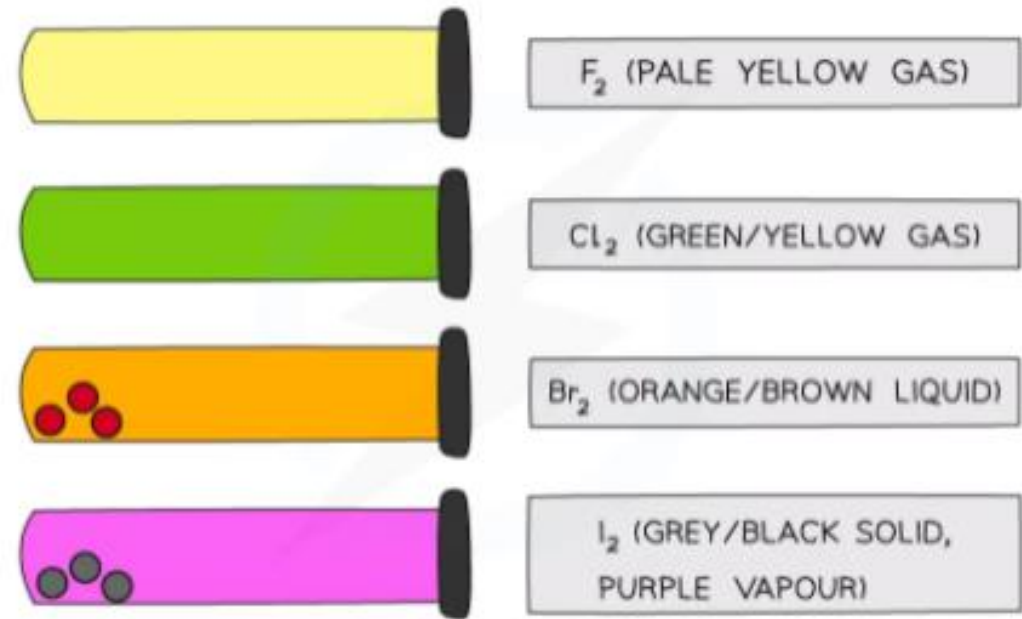
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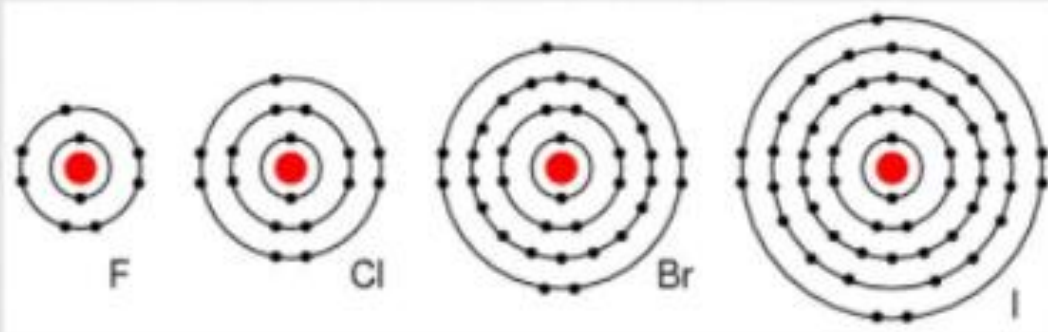
**Group 17
The Halogen Group**

	Fluorine 9 F
	Chlorine 17 Cl
	Bromine 35 Br
	Iodine 53 I
	Astatine 85 At

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Brought to you by:

7 Electrons in valence shell



Kumpulan 17 / Group 17 (Halogen)

F

Cl

Br

I

At



Kereaktifan bertambah / *Reactivity increases*

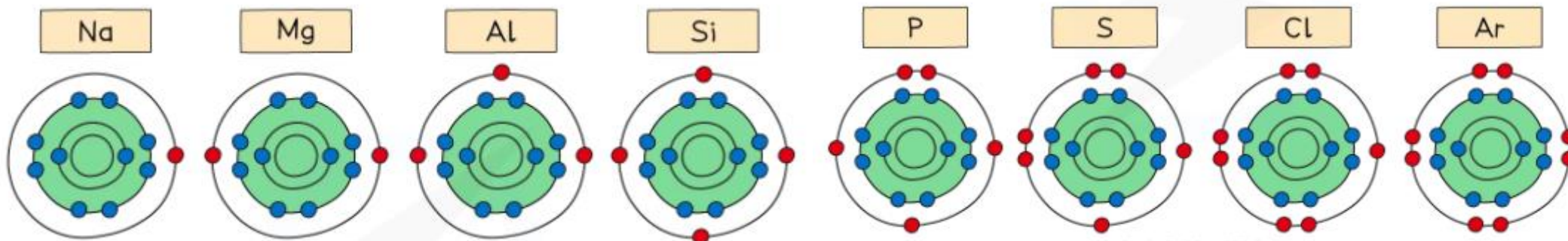
Saiz berkurang / *Size decreases*

Semakin ekeltronegatif / *Electronegativity*

Brought to you by:

Across a period

Unsur /Element	Na	Mg	Al	Si	P	S	Cl	Ar
Logam/bukan logam Metal/non-metal	Logam		separuh logam		bukan logam			
	Metal		Metalloid		non-metal			
Kelektronegatifan/ Electronegativity	Bertambah / increases							
Sifat oksida/ Property of oxide	Bes		amfoterik		asid			
	base		Amphoteric		Acid			



Brought to you by:

1

Pernyataan manakah yang menerangkan mengapa kereaktifan unsur-unsur Kumpulan 17 berkurang apabila menuruni kumpulan?

Which statement explains why the reactivity of Group 17 elements decreases when going down the group?

A Saiz atom semakin besar apabila menuruni kumpulan.

The size of atom becomes bigger when going down the group.

B Takat lebur dan takat didih bertambah apabila menuruni kumpulan.

The melting point and boiling point increase when going down the group.

C Kecenderungan nukleus atom menarik elektron berkurang.

The strength of nucleus of the atom to attract the electron decreases.

D Keadaan fizik unsur-unsur berubah daripada gas kepada cecair dan kemudian kepada pepejal pada suhu bilik.

The physical state of elements changes from gas to liquid then to solid at room temperature.

2

Jadual 2 menunjukkan sifat oksida bagi unsur-unsur R, S dan T. Unsur-unsur ini terletak pada Kala 3 dalam Jadual Berkala Unsur.

Table 2 shows the oxide property of elements R, S and T. These elements are in Period 3 in the Periodic Table of Elements.

Unsur Element	Sifat bagi oksida Property of oxide
R	Amfoterik Amphoteric
S	Berasid Acidic
T	Berbes Basic

Jadual 2 / Table 2

Susun ketiga-tiga unsur itu merentasi kala dari kiri ke kanan.

Arrange the three elements across the period from left to right.

A T, S, R

C S, R, T

B T, R, S

D R, S, T

Brought to you by:

3

Diagram 5 shows a group of elements in the Periodic Table of Elements.

Rajah 5 menunjukkan satu kumpulan unsur dalam Jadual Berkala Unsur.

19 9	F
35 17	Cl
80 35	Br
127 53	I

Diagram 5

Rajah 5

Which of the following is correct about the elements from iodine to fluorine?

Antara yang berikut, yang manakah betul tentang unsur tersebut daripada iodin ke fluorin?

- A Density increases
Ketumpatan bertambah
- B Atomic size increases
Saiz atom bertambah
- C Boiling point increases
Takat didih meningkat
- D Reactivity increases
Kereaktifan meningkat

4

Antara pernyataan berikut, yang manakah benar tentang unsur-unsur dalam Kumpulan 17 Jadual Berkala Unsur?

Which of the following statements is true about the elements in Group 17 of the Periodic Table of Elements?

- A Semua unsurnya mempunyai keelektronegatifan yang rendah.
All of the elements have low electronegativity.
- B Semua unsurnya mempunyai tujuh elektron valens.
All of the elements have seven valence electrons.
- C Semua unsurnya wujud sebagai molekul monoatom.
All of the elements exist as monoatomic molecules.
- D Semua unsurnya bertindak balas cergas dengan larutan natrium hidroksida pada suhu bilik.
All of the elements react vigorously with sodium hydroxide solution at room temperature.

Brought to you by:

5

Atom unsur *X* mempunyai nombor proton 15. Di manakah kedudukan *X* dalam Jadual Berkala Unsur?

The atoms of element X have a proton number of 15. Where is X located in the Periodic Table of Elements?

	Kumpulan Group	Kala Period
A	5	2
B	5	3
C	15	2
D	15	3

6 Rajah 2 menunjukkan dua kegunaan unsur-unsur daripada satu kumpulan dalam Jadual Berkala Unsur. Antara yang berikut, yang manakah betul mengenai perubahan sifat unsur apabila menuruni kumpulan dalam Jadual Berkala Unsur?

Diagram 2 shows two uses of elements from a group in the Periodic Table of Elements. Which of the following is correct about the change in the property of elements when going down the group in the Periodic Table of Elements?



Denyar kamera
Camera flash



Mentol lampu
Light bulb

Rajah 2 / Diagram 2

- A Ketumpatan berkurang
Density decreases
- B Boleh mengkonduksikan arus elektrik
Can conduct electricity
- C Jisim atom relatif berkurang
The relative atomic mass decreases
- D Takat lebur dan takat didih bertambah
Melting point and boiling point increase

7 *X* ialah unsur yang mempunyai sifat-sifat berikut:
X is an element that has the following properties:

- Pepejal lembut
Soft solid
- Bertindak balas dengan air sejuk membentuk larutan beralkali
Reacts with cold water to form alkaline solution
- Disimpan di dalam minyak parafin
Stored in paraffin oil

Antara unsur A, B, C dan D di dalam Jadual Berkala Unsur berikut, unsur manakah yang mewakili *X*?

Among elements A, B, C and D in the Periodic Table of Elements, which element represents as X?

A							D
	B			C			

Brought to you by:

8

Unsur P , Q dan R berada pada kala yang sama dalam Jadual Berkala Unsur. Setiap unsur menunjukkan ciri-ciri yang berbeza seperti berikut?

Elements P , Q and R are placed in the same period in the Periodic Table of Elements. Each element shows different properties as follows.

- Oksida P bertindak balas dengan kedua-dua asid hidroklorik dan larutan natrium hidroksida.
Oxide of element P reacts with both hydrochloric acid and sodium hydroxide.
- Oksida Q larut di dalam air menghasilkan larutan tak berwarna yang mempunyai pH 14.
Oxide of element Q dissolves in water to form a colourless solution of pH 14.
- Oksida R larut di dalam air menghasilkan larutan tak berwarna yang menukarkan kertas litmus biru ke merah.
Oxide of element R dissolves in water to form a solution that turns blue litmus paper to red.

Antara yang berikut, yang manakah menunjukkan susunan P , Q dan R mengikut tertib menurun nombor proton?

Which of the following shows P , Q and R in order of decreasing proton number?

A P, Q, R

B R, P, Q

C R, Q, P

D Q, P, R

Brought to you by:

[illegible]

Jadual 3 / Table 3

(a) Write the formula of ion that is formed from atom X. [1]

(i) Write one chemical equation for the reaction.
[2]

(ii) If element V in Table 3 is replaced by element W, state one observation[1]

(c) Why does the atomic size of the elements decreases when going across the period from left to right. Explain.[2]

Brought to you by:

[illegible]

- (i) Write the electron arrangement of ion Q.[1]
- (ii) Both of element P and element Q react with cold water. Explain why element Q is more reactive than element P [3]
- (iii) Write the chemical equation for the reaction between element P and element T. [2]
- (iv) Element R reacts with oxygen gas to form an amphoteric oxide. What is meant by amphoteric oxide?[1]
- (v) Arrange elements Q, R, S, T and U in ascending order of atomic size. [1]
- Brought to you by:

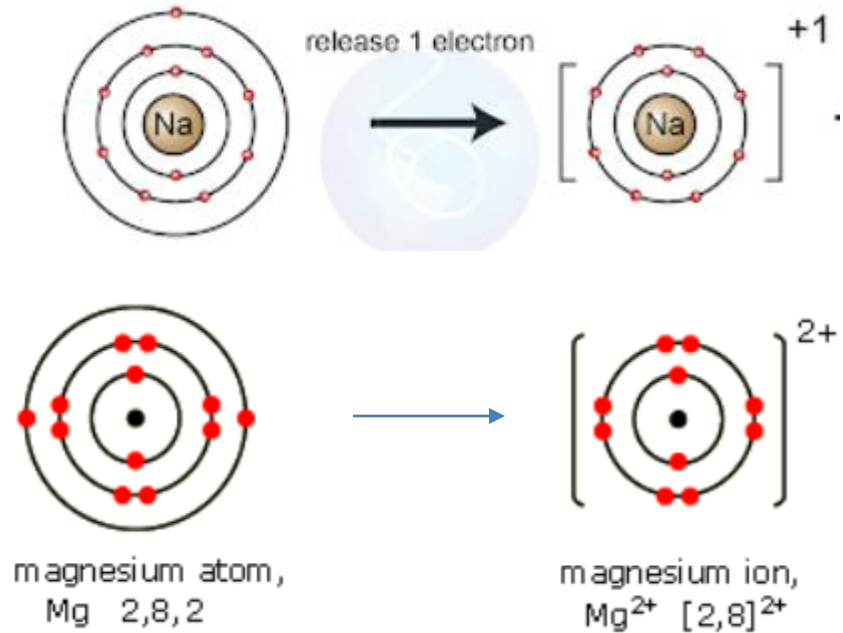
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IONIC AND COVALENT BONDS

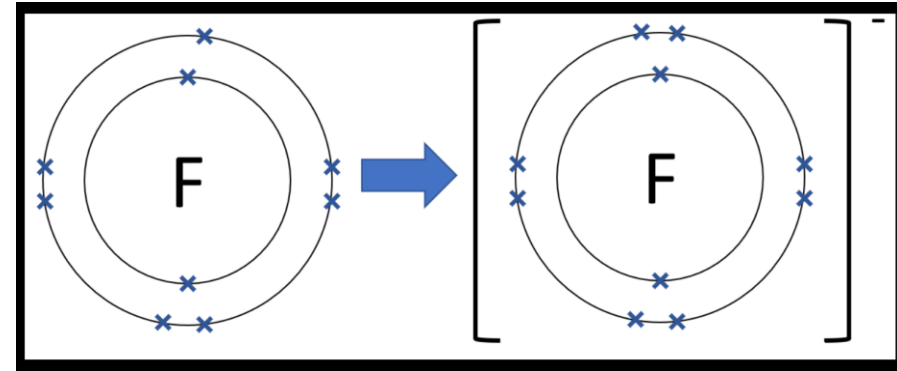
	Group							Number of occupied shells
	1	2	3	4	5	6	7	0/18
Period 1								2 He 2 1
Period 2	3 Li 2.1	4 Be 2.2	5 B 2.3	6 C 2.4	7 N 2.5	8 O 2.6	9 F 2.7	10 Ne 2.8 2
Period 3	11 Na 2.8.1	12 Mg 2.8.2	13 Al 2.8.3	14 Si 2.8.4	15 P 2.8.5	16 S 2.8.6	17 Cl 2.8.7	18 Ar 2.8.8 3
Period 4	19 K 2.8.8.1	20 Ca 2.8.8.2						4

Brought to you by:

FORMATION OF POSITIVE ION



FORMATION OF NEGATIVE ION



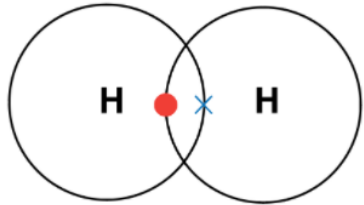
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Metal atoms and non-metal atoms go in opposite directions when they ionise:

<u>Susunan elektron</u> <u>Dalam atom logam/</u> <i>Electron arrangement of metal atoms</i>	<u>Susunan elektron dalam atom</u> <u>bukan logam/</u> <i>Electron arrangement of non-metal atoms</i>
2.1 2.2 2.8.1 2.8.2 2.8.3 2.8.8.1 2.8.8.2	2.6 2.7 2.8.6 2.8.7

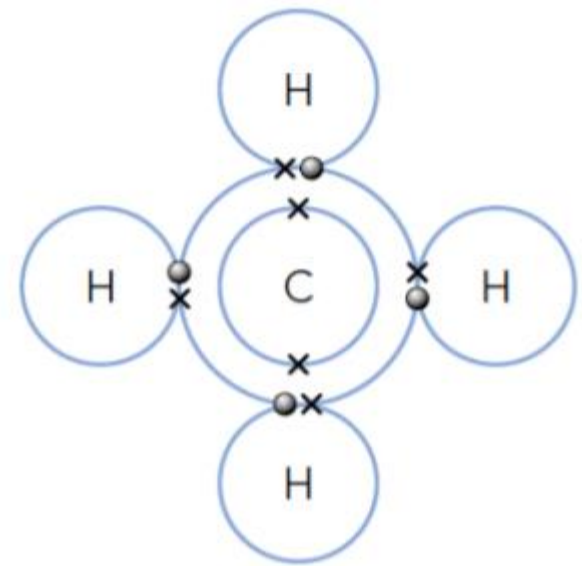
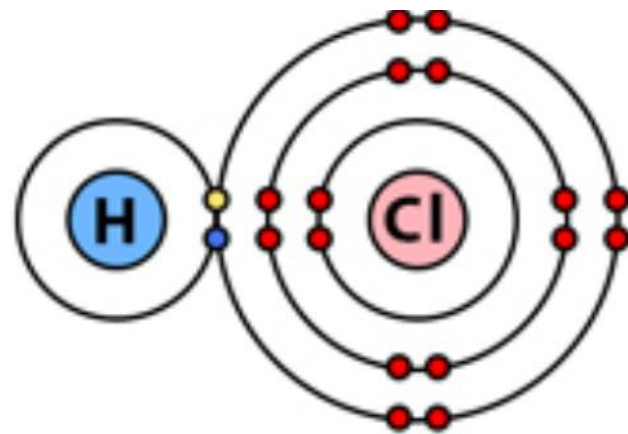
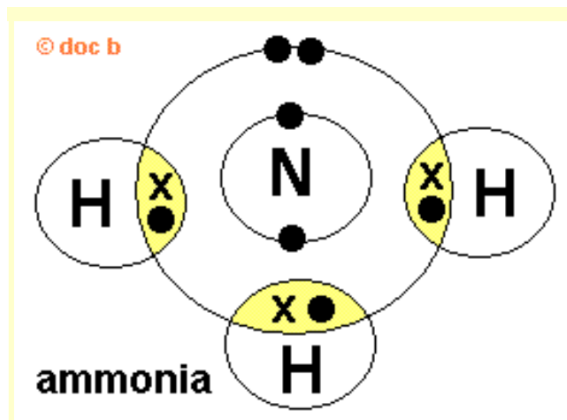
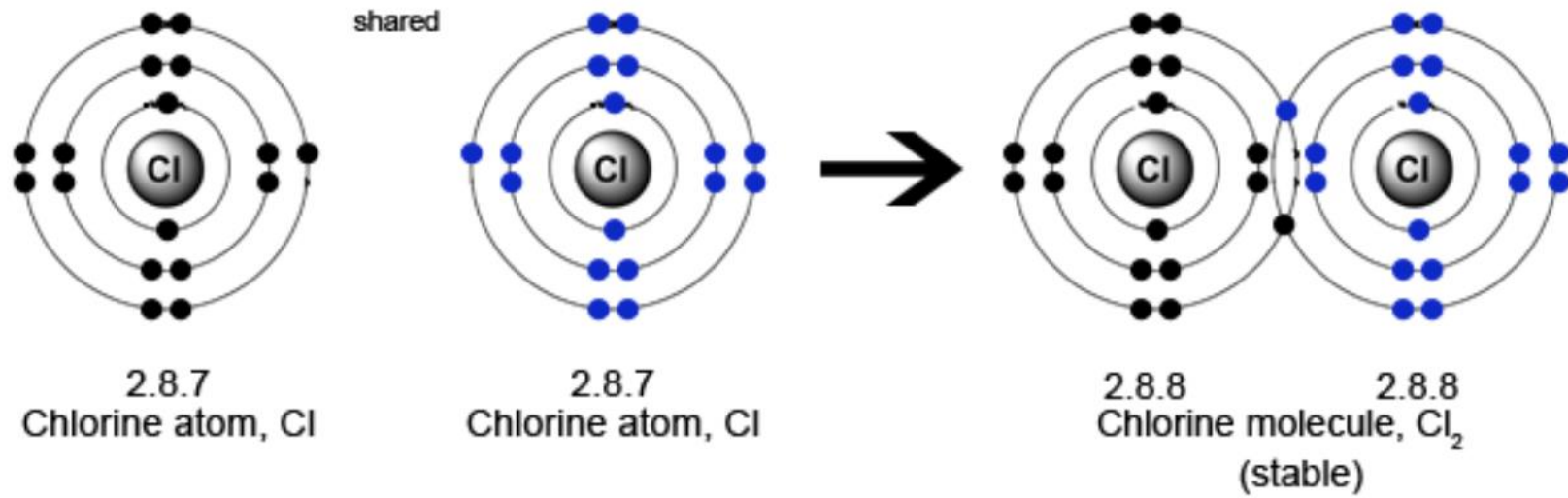
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Formation of covalent bonds



	Group							Number of occupied shells	
	1	2	3	4	5	6	7	0/18	
Period 1								2 He 2	1
Period 2	3 Li 2.1	4 Be 2.2	5 B 2.3	6 C 2.4	7 N 2.5	8 O 2.6	9 F 2.7	10 Ne 2.8	2
Period 3	11 Na 2.8.1	12 Mg 2.8.2	13 Al 2.8.3	14 Si 2.8.4	15 P 2.8.5	16 S 2.8.6	17 Cl 2.8.7	18 Ar 2.8.8	3
Period 4	19 K 2.8.8.1	20 Ca 2.8.8.2							4

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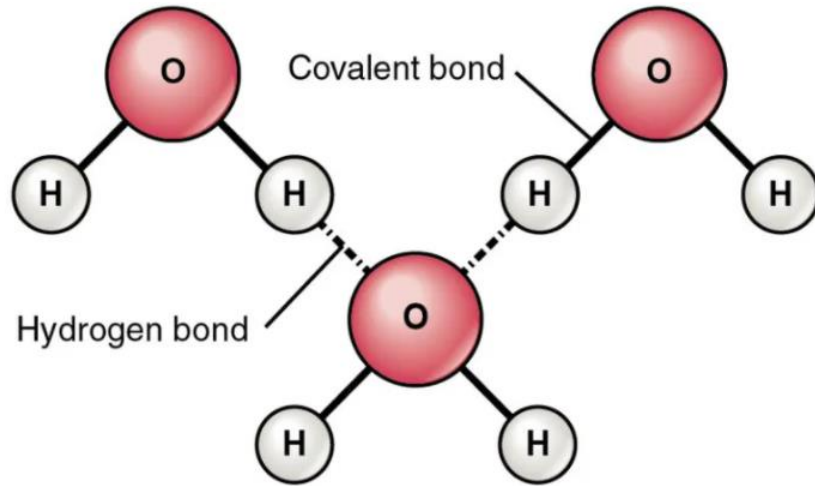
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How Many Bonds????

Group	Hydrogen	14	15	16	17
Valence electrons	1	4	5	6	7
Valency	1	4	3	2	1
Number of bonds	1	4	3	2	1

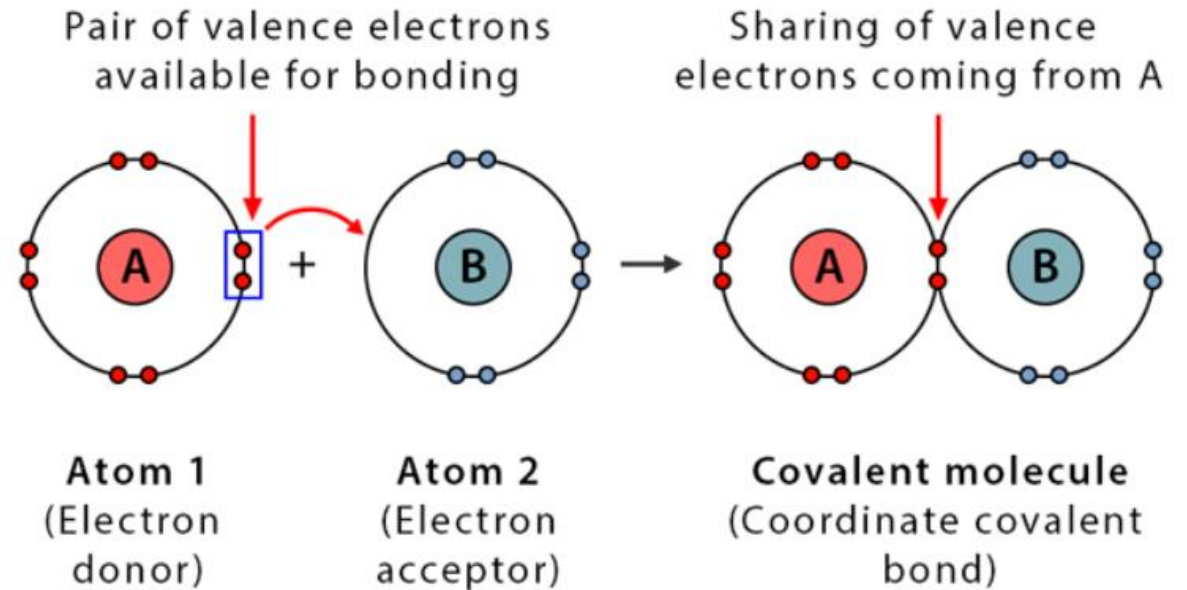
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Hydrogen bond



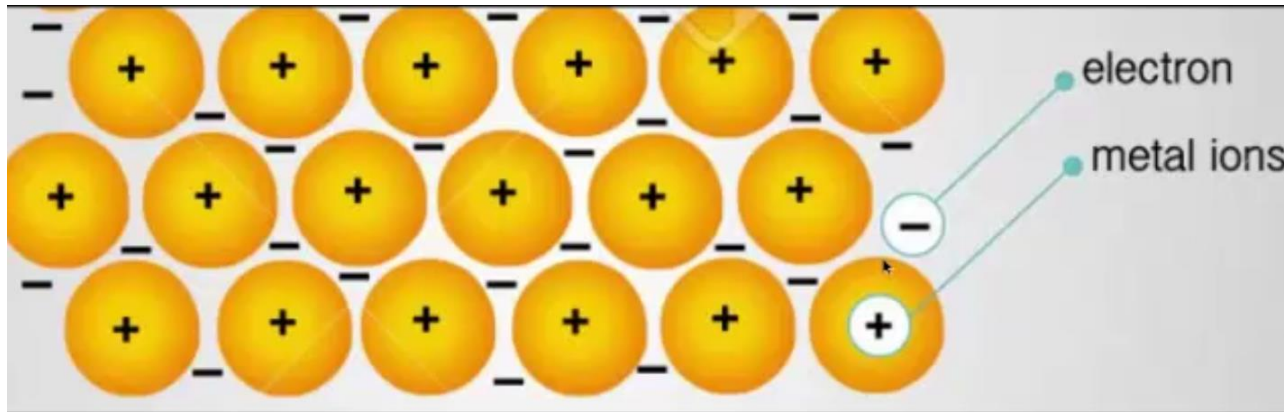
Hydrogen bonding is a special type of attraction between molecules not a covalent bond to a hydrogen atom. It results from the attractive force between a hydrogen atom covalently bonded to a very electronegative atom such as a N, O, or F atom

Dative bond



Brought to you by:

Metallic bond

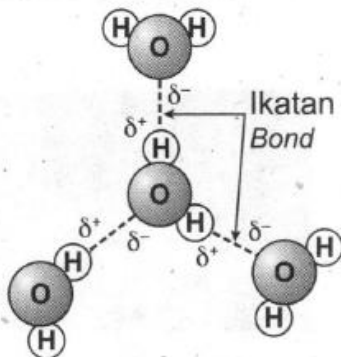


Metallic bonding the electrostatic attractive force between a cloud of delocalised electrons and positively charged metal ions.

Brought to you by:

11

Rajah 3 menunjukkan ikatan dalam satu sebatian.
Diagram 3 shows the formation of a bond in a compound.



Rajah 3 / Diagram 3

Pernyataan manakah yang betul tentang ikatan tersebut?

Which statement is correct about the bond?

A Ikatan terbentuk apabila atom-atom logam berkongsi elektron untuk mencapai satu susunan yang stabil.

A bond is formed when metal atoms share electrons to achieve a stable electron arrangement.

B Ikatan terbentuk oleh daya tarikan yang lemah antara atom logam dengan atom bukan logam.

A bond is formed by weak attraction force between metal and non-metal atoms.

C Daya tarikan antara atom hidrogen, H yang terikat dengan atom yang mempunyai keelektronegatifan yang tinggi.

Attraction force between hydrogen atom, H that is bonded to an atom of high electronegativity.

D Ikatan terbentuk apabila pasangan elektron yang dikongsi berasal daripada satu atom sahaja.

A bond is formed when the electron pair shared comes from one atom only.

12. Jadual 2 menunjukkan susunan elektron bagi unsur P dan unsur Q.

Table 2 shows the electron arrangements of element P and element Q.

Unsur P / Element P	Unsur Q / Element Q
2.8.2	2.6

Jadual 2 / Table 2

Apakah formula dan jenis ikatan bagi sebatian yang terbentuk daripada tindak balas antara P dengan Q?

What is the formula and the type of bond of the compound formed from the reaction between P and Q?

	Formula molekul Molecular formula	Jenis ikatan Type of bond
A	P_2Q	Ion Ionic
B	$P_2'Q$	Kovalen Covalent
C	PQ	Kovalen Covalent
D	PQ	Ion Ionic

Brought to you by:

13. Jadual 3 menunjukkan dua sebatian kovalen yang berbeza.

Table 3 shows two different covalent compounds.

Nama sebatian Name of compound	Silikon dioksida Silicon dioxide	Sulfur trioksida Sulphur trioxide
Takat lebur (°C) Melting point (°C)	1710	16.8

Jadual 3 / Table 3

Pernyataan manakah yang menerangkan mengapa silikon dioksida mempunyai takat lebur yang lebih tinggi daripada sulfur trioksida?
Which statement explains why silicon dioxide has a higher melting point than sulphur trioxide?

- A Ion-ion di dalam sebatian itu berada pada kedudukan yang tetap di dalam kekisinya.
The position of ions in the compound is fixed in the lattice.
- B Ion-ion dipegang bersama oleh daya tarikan elektrostatik yang kuat.
The ions are held together by strong electrostatic attraction forces.
- C Semua atom terikat dengan semua atom lain oleh ikatan kovalen yang kuat.
All the atoms are bonded to all other atoms by strong covalent bonds.
- D Molekul yang bersaiz besar ditarik bersama oleh daya tarikan Van der Waals.
The big size molecules are attracted together by Van der Waals attraction forces.

14

Jadual 1 menunjukkan maklumat tentang kekonduksian elektrik bagi bahan P, Q dan R.

Table 1 shows the information about the electrical conductivity of substances P, Q and R.

Bahan Substance	P	Q	R
Adakah pepejalnya mengalirkan arus elektrik? Does its solid conduct electricity?	✓	✗	✗
Adakah cecairnya mengalirkan arus elektrik? Does its liquid conduct electricity?	✓	✗	✓

Jadual 1 Table 1

Antara pernyataan berikut, yang manakah benar?
Which of the following statements is true?

- A Pepejal P dan leburan P mengandungi ion-ion yang bebas bergerak.
Solid P and molten P contain freely moving ions.
- B Pepejal Q dan leburan Q mengandungi atom.
Solid Q and molten Q contain atoms.
- C Tiada ion dalam pepejal R.
There are no ions in solid R.
- D Leburan R mengandungi ion-ion yang bebas bergerak.
Molten R contains freely moving ions.

15

Antara berikut, pernyataan yang manakah benar tentang pembentukan ion ammonium, NH_4^+ ?

Which of the following statements is true about the formation of ammonium ion, NH_4^+ ?

- A** Sepasang elektron dikongsi antara ion-ion hidrogen dan satu atom nitrogen.
A pair of electrons is shared between hydrogen ions and a nitrogen atom.
- B** Sepasang elektron dikongsi antara atom-atom hidrogen dan satu atom nitrogen.
A pair of electrons is shared between hydrogen atoms and a nitrogen atom.
- C** Satu atom nitrogen berkongsi sepasang elektron bebas dengan satu atom hidrogen.
A nitrogen atom shares a pair of free electrons with one hydrogen atom.
- D** Satu ion nitrogen berkongsi sepasang elektron bebas dengan satu ion hidrogen.
A nitrogen ion shares a pair of free electrons with one hydrogen ion.

16 Table 3 shows the boiling point of hydrogen fluoride and hydrogen chloride.

Sebatian Compound	Takat didih ($^{\circ}\text{C}$) Boiling point ($^{\circ}\text{C}$)
Hidrogen fluorida Hydrogen fluoride	19.5 $^{\circ}\text{C}$
Hidrogen klorida Hydrogen chloride	-85.05 $^{\circ}\text{C}$

Jadual 3 / Table 3

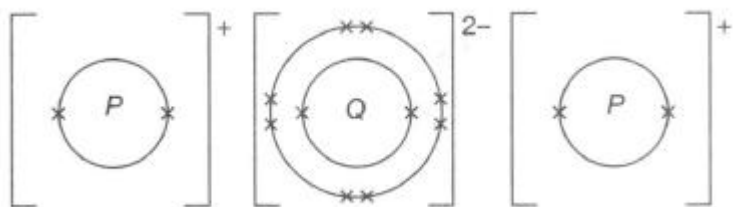
Pernyataan manakah yang menjelaskan perbezaan takat didih bagi dua sebatian ini?
Which of the statement explains the difference of boiling point for these two substances?

- A** Lebih banyak tenaga haba diperlukan untuk mengatasi daya tarikan elektrostatik antara ion dalam hidrogen fluorida.
More heat energy is needed to overcome the electrostatic attraction force between ions in hydrogen fluoride.
- B** Sedikit tenaga haba diperlukan untuk mengatasi ikatan hidrogen antara molekul hidrogen klorida.
Less heat energy is needed to overcome the hydrogen bonding between hydrogen chloride molecules.
- C** Kekuatan ikatan kovalen antara atom dalam hidrogen klorida bertambah.
Increase in strength of the covalent bond between the atoms in hydrogen chloride.
- D** Jisim molekul relatif hidrogen klorida lebih tinggi.
The relative molecular mass of hydrogen chloride is higher.

17

Rajah 5 menunjukkan susunan elektron bagi sebatian yang terbentuk antara unsur *P* dengan unsur *Q*.

Diagram 5 shows the electron arrangement of a compound formed between element P and element Q.



Unsur *Q* terletak dalam Kumpulan mana dalam Jadual Berkala Unsur?

In which Group of the Periodic Table of Elements is element Q located?

- A 2
- B 8
- C 16
- D 18

18

Rajah 7 menunjukkan maklumat tentang atom *X* dan *Y*.

Diagram 7 shows information about atoms X and Y.



Rajah 7 *Diagram 7*

Apakah formula bagi sebatian yang terbentuk antara *X* dan *Y*?

What is the formula of the compound formed between X and Y?

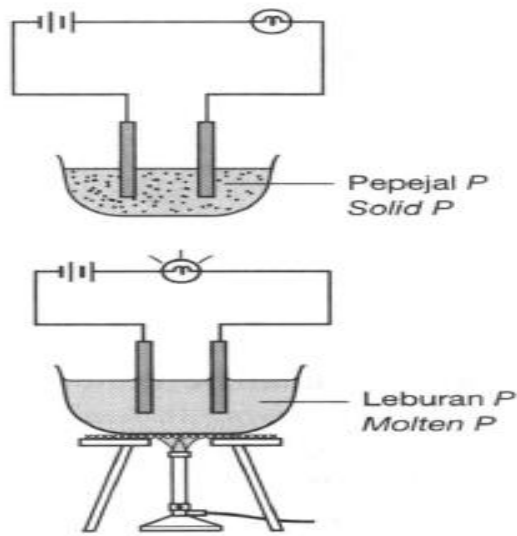
- A XY
- B XY_2
- C XY_3
- D XY_4

Brought to you by:

19

Rajah 3 menunjukkan pemerhatian suatu eksperimen untuk mengkaji kekonduksian elektrik bahan *P* dalam keadaan pepejal dan leburan.

Diagram 3 shows the observations of an experiment studying the electrical conductivity of material *P* in solid and molten states.



Rajah 3 Diagram 3

Antara berikut, yang manakah benar tentang *P*?

Which of the following is true about *P*?

- A *P* wujud sebagai atom dalam keadaan pepejal.
P exists as atoms in a solid state.
- B *P* mempunyai ion-ion yang berlawanan cas dalam keadaan leburan.
P has oppositely charged ions in a molten state.
- C *P* mempunyai elektron yang bergerak bebas dalam keadaan leburan.
P has freely moving electrons in a molten state.
- D *P* mempunyai ion-ion yang bergerak bebas dalam keadaan leburan.
P has freely moving ions in a molten condition.

20

J dan *K* ialah dua unsur yang masing-masing mempunyai nombor proton 4 dan 9.

Jenis ikatan dan sifat fizik manakah yang menerangkan sebatian yang terbentuk antara *J* dan *K*?

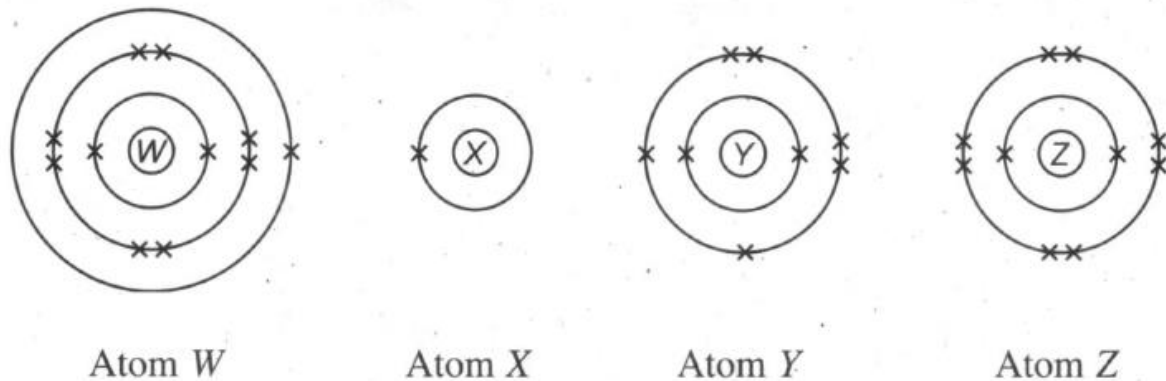
J and *K* are two elements with proton number 4 and 9 respectively.

Which type of bond and physical property describe the compound formed between *J* and *K*?

	Ikatan kimia Chemical bond	Sifat fizik Physical property
A	Ikatan ion <i>Ionic bond</i>	Mudah meruap <i>Volatile</i>
B	Ikatan ion <i>Ionic bond</i>	Mengkonduksikan arus elektrik dalam keadaan akueus <i>Conducts electricity in aqueous state</i>
C	Ikatan kovalen <i>Covalent bond</i>	Mempunyai takat lebur dan takat didih yang rendah <i>Has low melting point and boiling point</i>
D	Ikatan kovalen <i>Covalent bond</i>	Larut dalam pelarut organik <i>Dissolves in organic solvent</i>

Brought to you by:

21. Diagram 4 shows the electron arrangements of atoms W, X, Y and Z.



Rajah 4 / Diagram 4

(a) Atom Y shares electrons with an atom to form a solvent that can dissolve substances and show their acidic and alkaline properties. State the atom. [1]

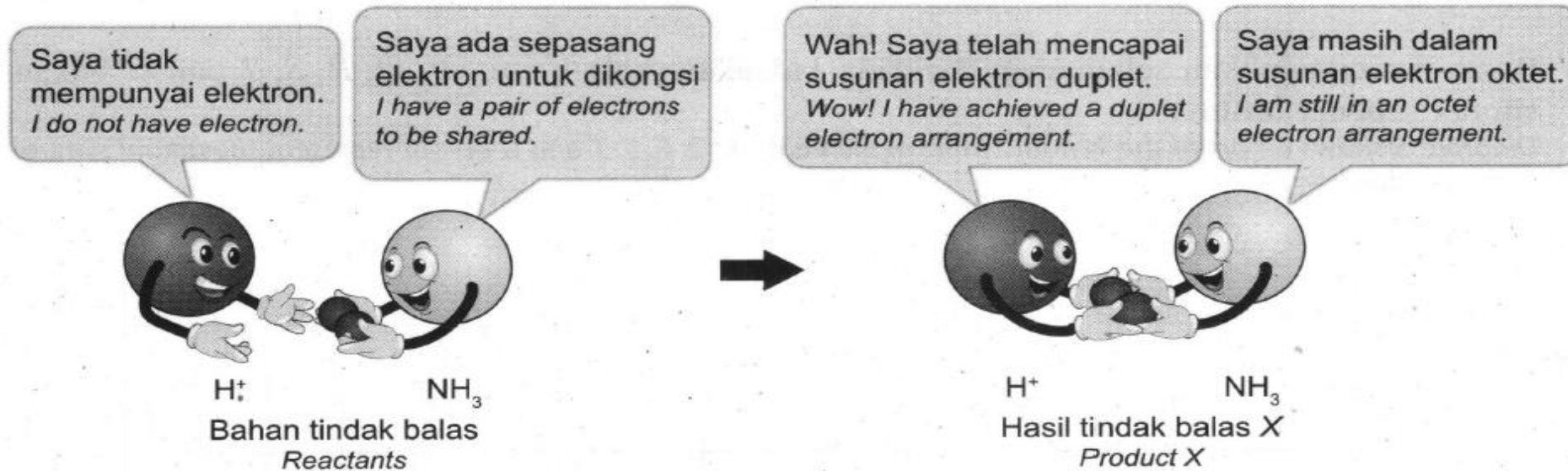
(b) Explain how a dative bond is formed in hydroxonium ion, H_3O^+ . [2]

(c) Draw the electron arrangement for a compound that has high melting point and boiling point at room temperature [2]

(d) Explain why the melting point and boiling point of compound in 4(a) and 4(c) are different. [2]

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22. Diagram 4 shows the reaction between hydrogen ion and ammonia



(a) Based on the Diagram 4,
(i) name product X. [1]

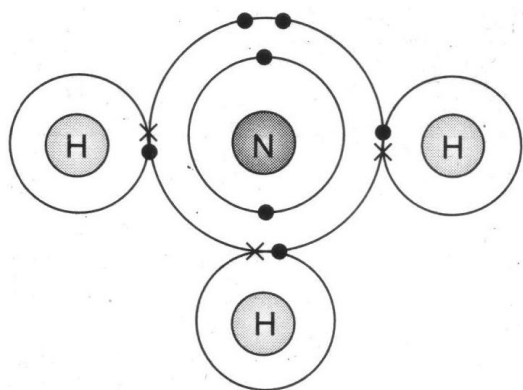
(iii) Explain the formation of the ion in (a)(i). [3]

(iv) draw the formation of this bond. [2]

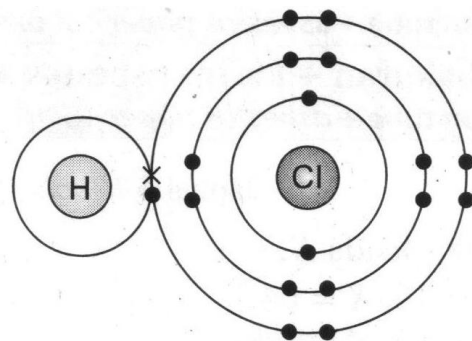
(ii) state the type of bond formation involved.[1]

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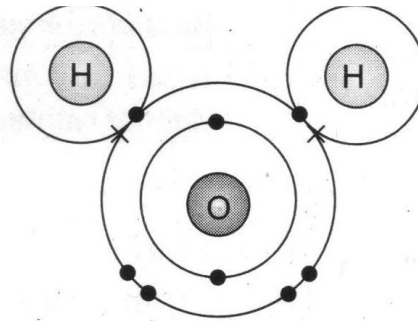
23. Diagram 4.1 shows three diagrams of electron arrangement for compounds E, F and G.



Sebatian *E*
Compound *E*



Sebatian *F*
Compound *F*



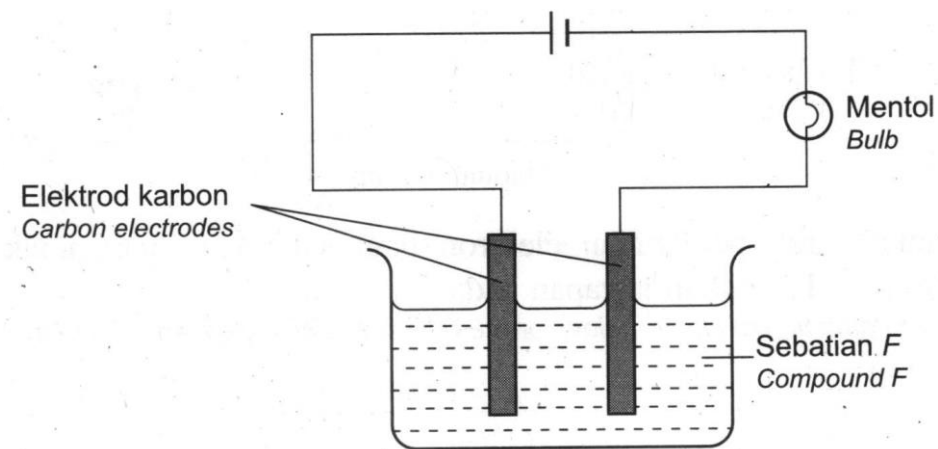
Sebatian *G*
Compound *G*

- (a) State the type of compound for compound E. [1]
- (b) Compound F and compound G can react with compound E respectively. State the name of the new bond formed between:
- Compound E and compound F
 - Compound E and compound G [2]

(c) (i) Compare the amount of heat needed to overcome the attraction forces within molecules E and the bonds between molecules E.[1]

(ii) State the physical property of compound E based on your answer in 4(c)(i).[1]

(d) Diagram 4.2 shows the apparatus set-up to investigate the conductivity of aqueous compound F.

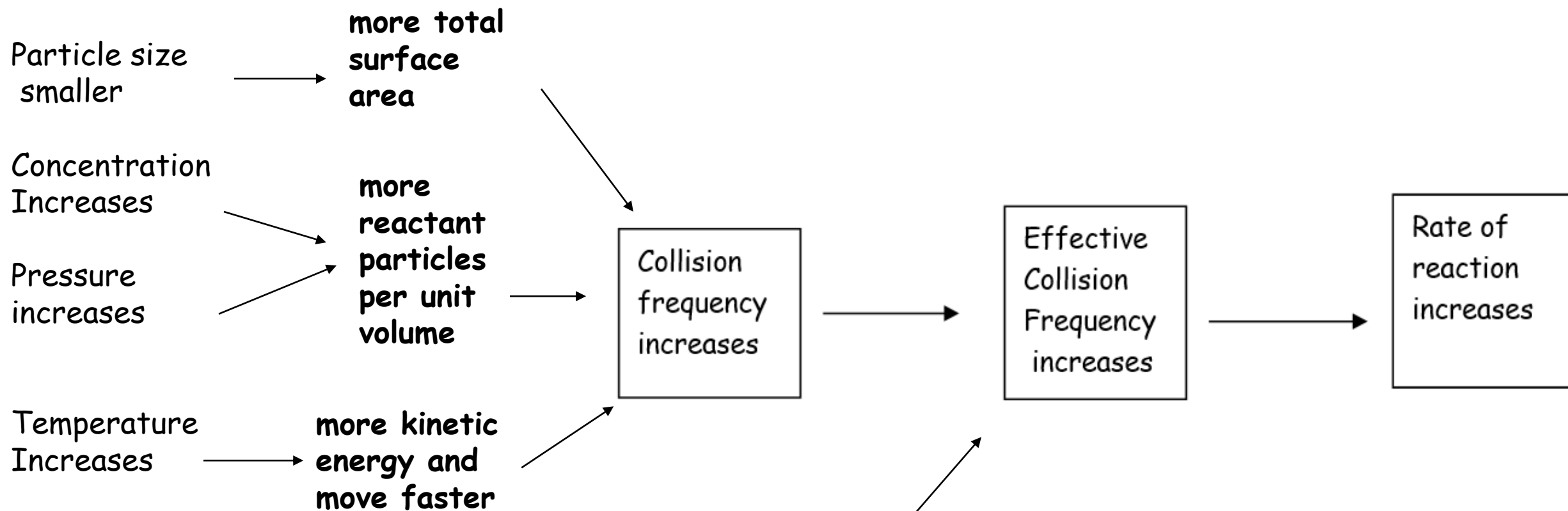


Explain the observation in Diagram 4.2. [2]

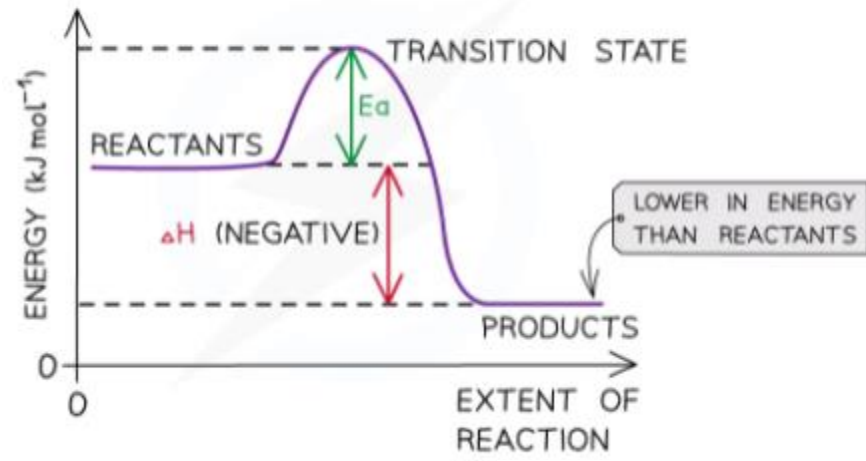
Brought to you by:

Rate of reaction

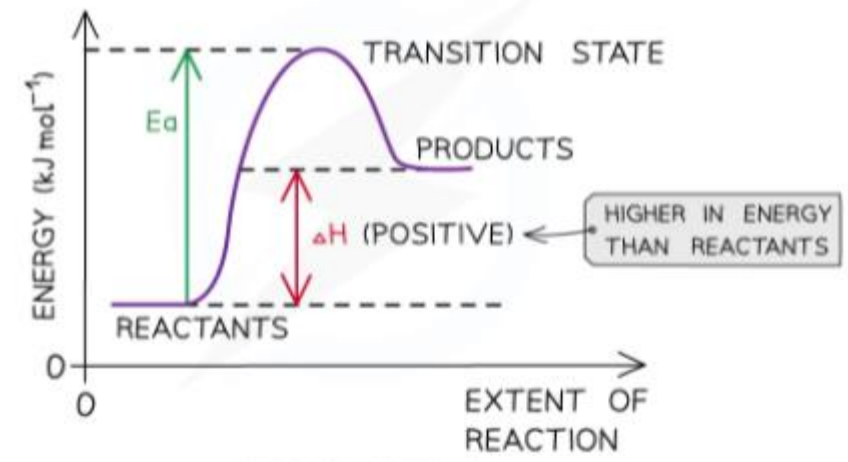
Factors that effect the rate of reaction



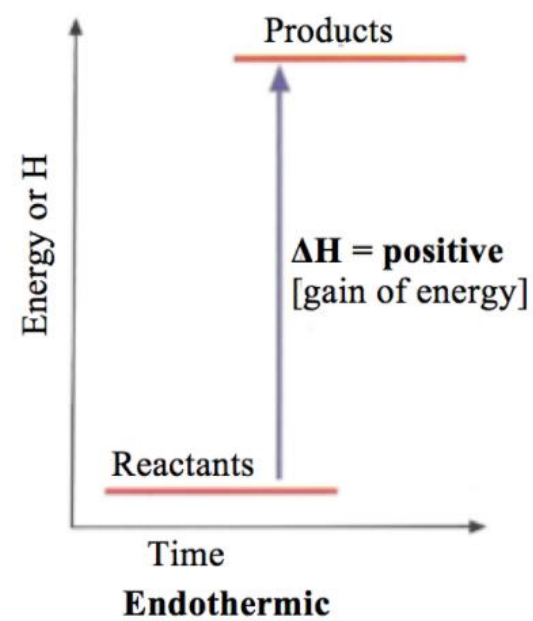
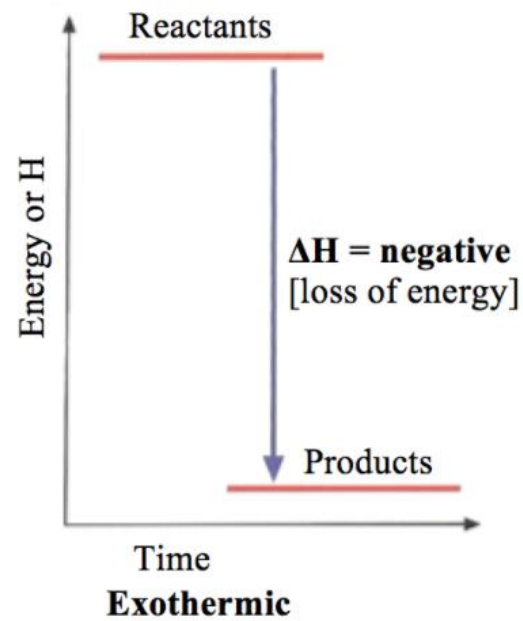
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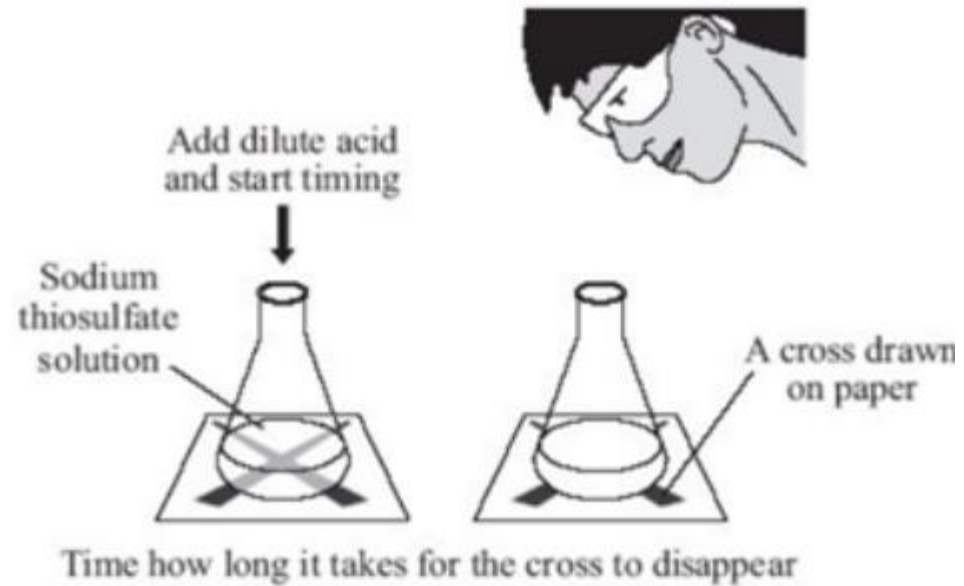
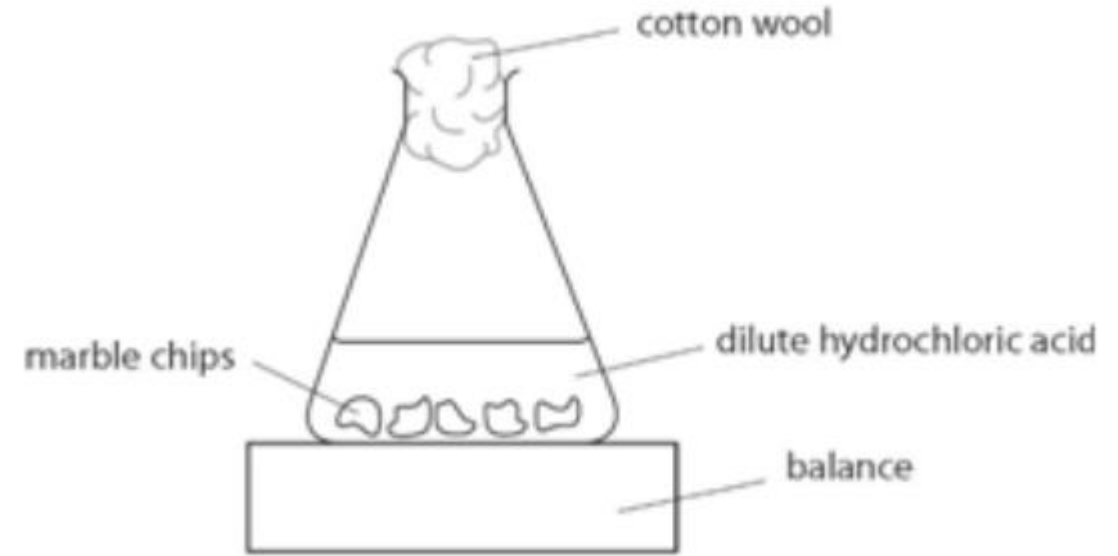
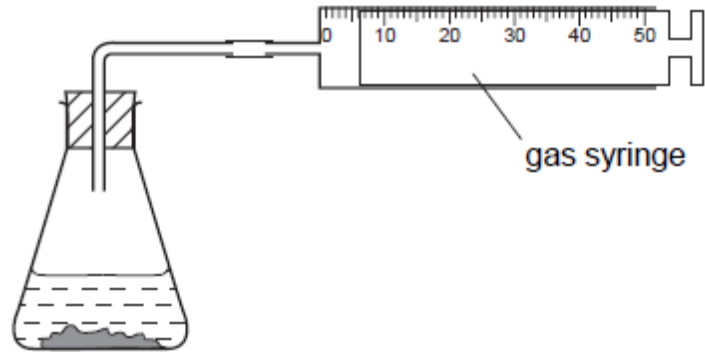
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24

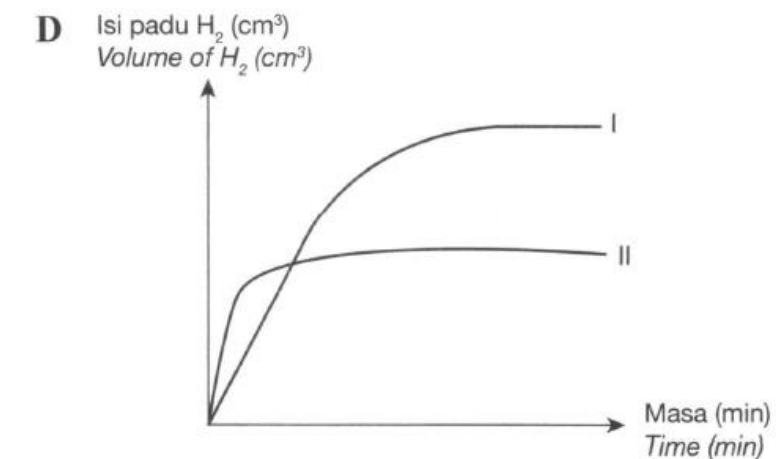
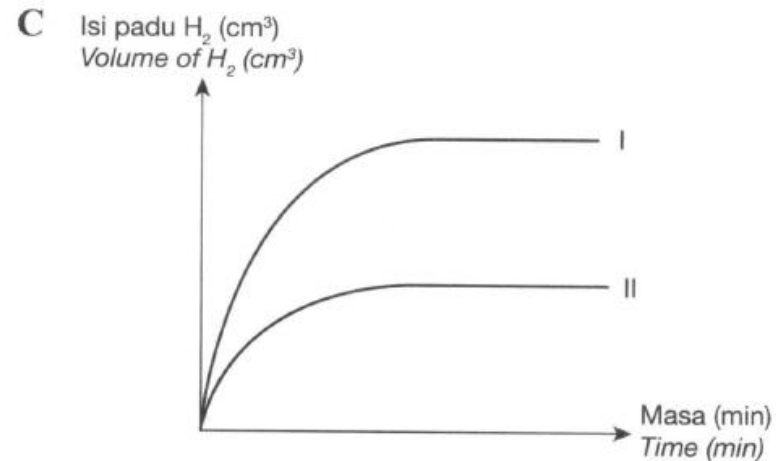
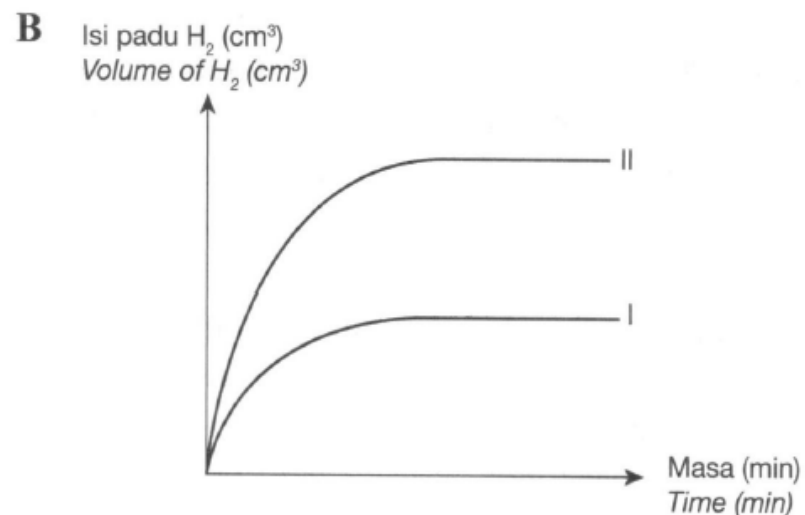
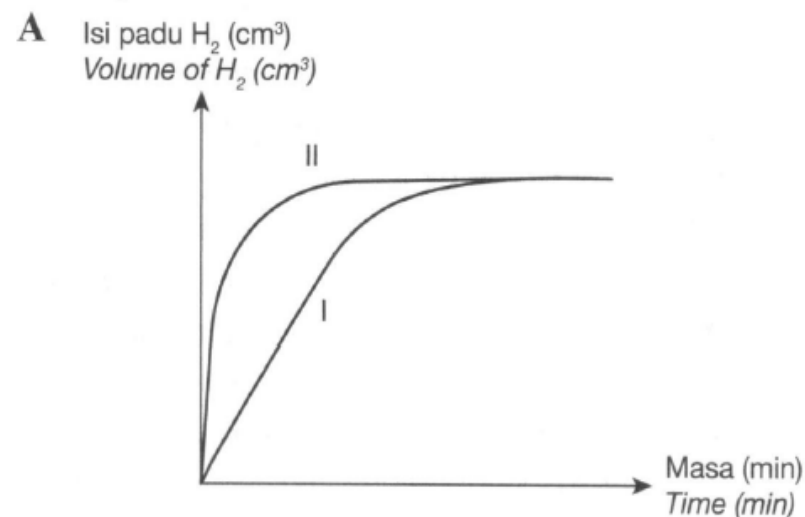
Jadual 3 menunjukkan dua eksperimen yang dijalankan untuk mengkaji kadar tindak balas antara zink dengan asid hidroklorik yang membebaskan gas hidrogen.

Table 3 shows two experiments carried out to study the rate of reaction between zinc and hydrochloric acid that produces hydrogen gas.

Eksperimen Experiment	Bahan Substances
I	Ketulan zink berlebihan + 100 cm ³ asid hidroklorik 0.5 mol dm ⁻³ <i>Excess zinc granules + 100 cm³ of 0.5 mol dm⁻³ hydrochloric acid</i>
II	Serbuk zink berlebihan + 25 cm ³ asid hidroklorik 1.0 mol dm ⁻³ <i>Excess zinc powder + 25 cm³ of 1.0 mol dm⁻³ hydrochloric acid</i>

Antara berikut, yang manakah mewakili keputusan kedua-dua eksperimen itu?

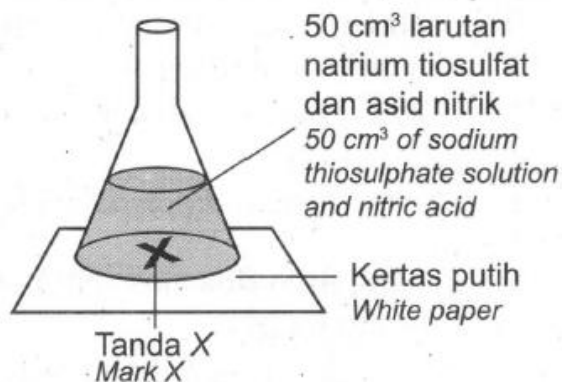
Which of the following graphs represents the results for both experiments?



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Rajah 6 menunjukkan suatu eksperimen untuk menentukan kadar tindak balas antara natrium tiosulfat dengan asid nitrik.

Diagram 6 shows the experiment to determine the rate of reaction between sodium thiosulphate and nitric acid.



Rajah 6 / Diagram 6

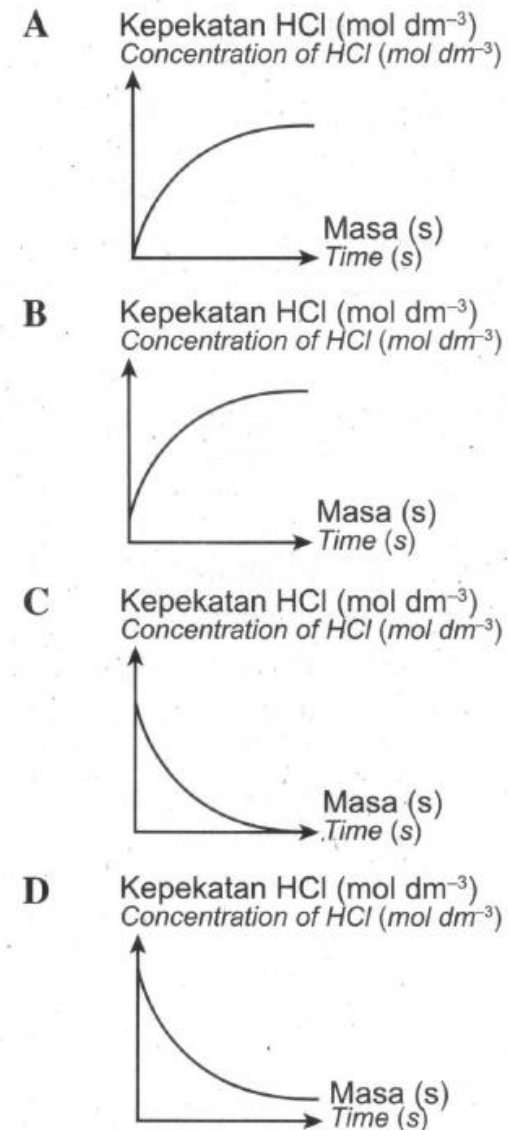
Kombinasi manakah yang mengambil masa paling singkat untuk tanda X hilang daripada penglihatan?

Which combination takes the shortest time for mark X to disappear from sight?

	Kepekatan natrium tiosulfat (mol dm^{-3}) Concentration of sodium thiosulphate (mol dm^{-3})	Kepekatan asid sulfurik (mol dm^{-3}) Concentration of sulphuric acid (mol dm^{-3})	Suhu ($^{\circ}\text{C}$) Temperature ($^{\circ}\text{C}$)
A	1.0	2.0	40
B	1.0	1.0	55
C	1.0	1.0	40
D	1.0	2.0	55

26 Antara graf berikut, yang manakah betul menunjukkan perubahan kepekatan asid hidroklorik melawan masa apabila magnesium berlebihan bertindak balas dengan asid hidroklorik?

Which graph shows the correct change in the concentration of hydrochloric acid against time when excess magnesium reacts with hydrochloric acid?



Brought to you by:

27.

Jadual 5 menunjukkan empat eksperimen yang telah dijalankan oleh sekumpulan murid untuk mengkaji kadar tindak balas bagi penguraian hidrogen peroksida.

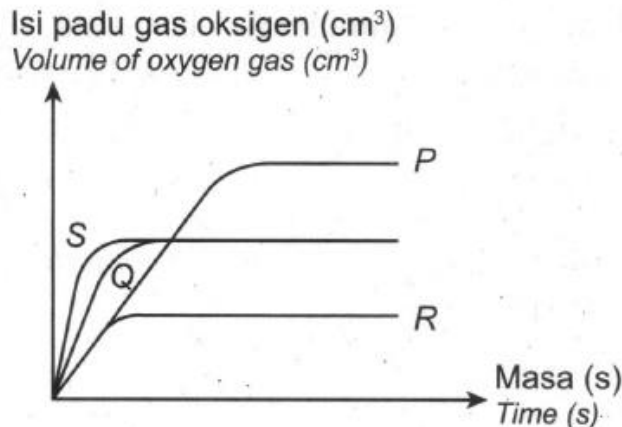
Table 5 shows four experiments conducted by a group of pupils to investigate the rate of decomposition of hydrogen peroxide solution.

Eksperimen Experiment	Larutan hidrogen peroksida Hydrogen peroxide solution		Suhu (°C) Temperature (°C)
	Isi padu (cm ³) Volume (cm ³)	Kepekatan (mol dm ⁻³) Concentration (mol dm ⁻³)	
I	25	2.0	25
II	50	1.5	25
III	15	1.5	25
IV	25	2.0	40

Jadual 5 / Table 5

Rajah 9 menunjukkan graf isi padu gas hidrogen melawan masa bagi eksperimen-eksperimen tersebut. Antara yang berikut, yang manakah mewakili keputusan eksperimen yang betul?

Diagram 9 shows the graph of volume of oxygen gas against time for the experiments. Which of the following represents the results for the experiments correctly?



Rajah 9 / Diagram 9

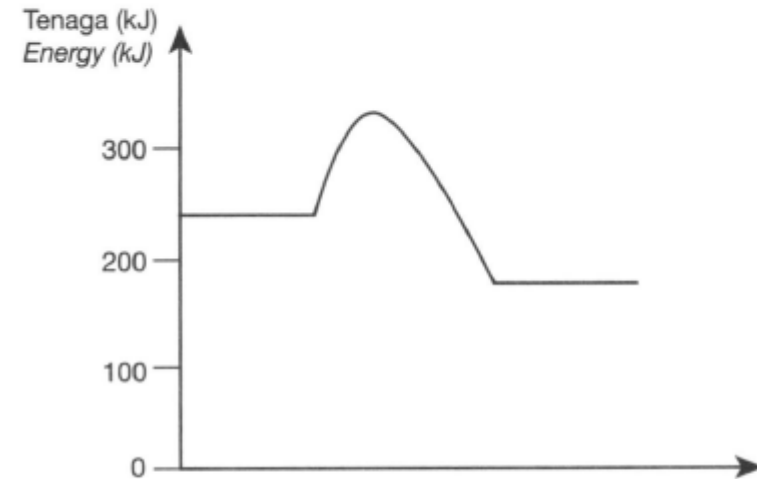
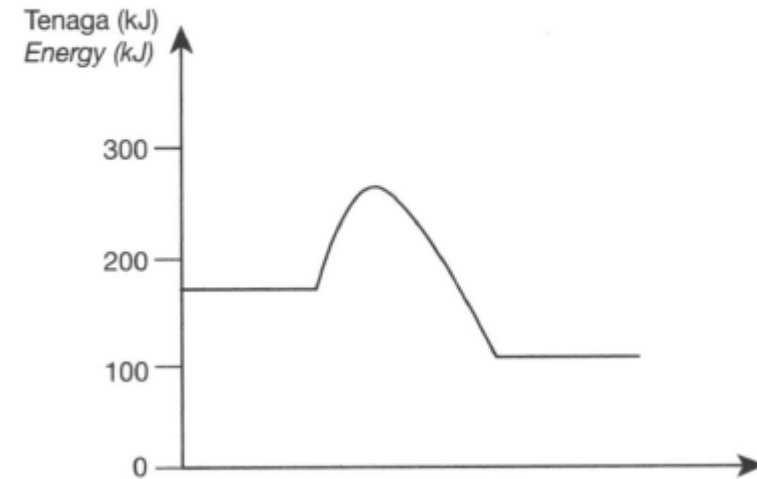
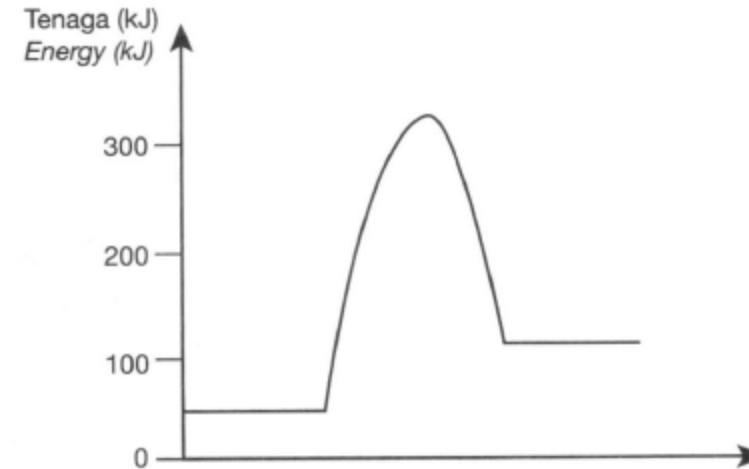
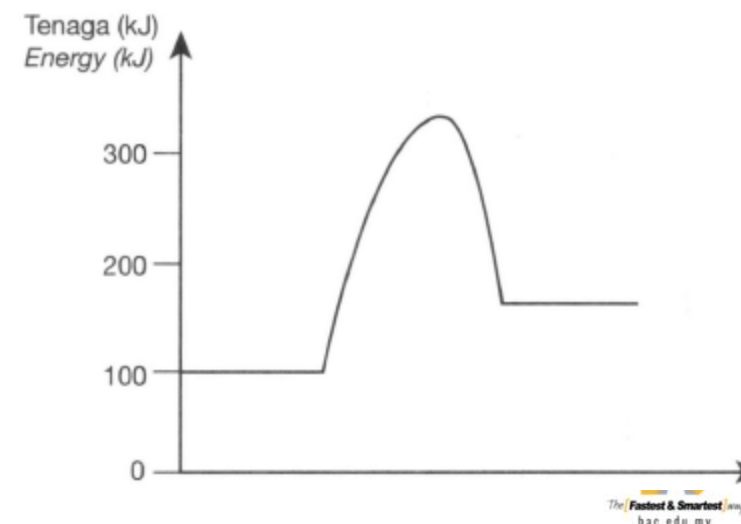
	I	II	III	IV
A	P	Q	S	R
B	Q	P	R	S
C	S	R	Q	P
D	R	S	P	Q

Brought to you by:

28.

Rajah profil tenaga manakah yang menunjukkan tenaga pengaktifan paling tinggi?

Which energy profile diagram shows the highest activation energy?

A**B****C****D**

i by:

29. Faktor manakah **tidak** mempengaruhi kadar penghasilan gas hidrogen dalam tindak balas antara magnesium dan asid hidroklorik?

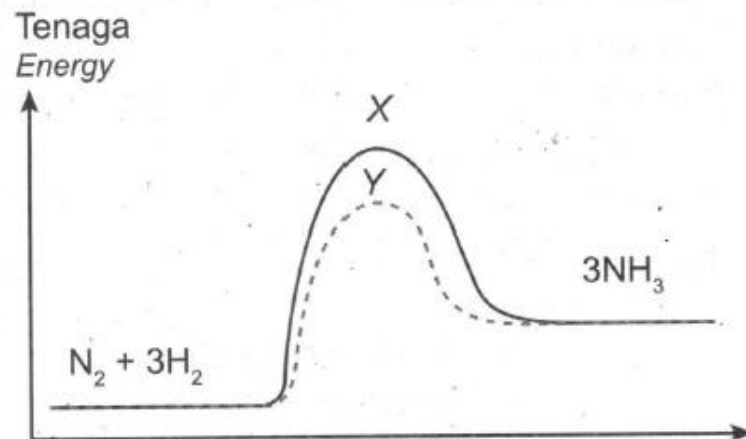
*Which factor will **not** influence the rate of hydrogen gas liberated in the reaction between magnesium and hydrochloric acid?*

- A Penambahan larutan kuprum(II) sulfat
Addition of copper(II) sulphate solution
- B Suhu asid hidroklorik
Temperature of hydrochloric acid
- C Kemolaran asid hidroklorik
Molarity of hydrochloric acid
- D Jenis radas yang digunakan
The type of apparatus used

30.

Rajah 7 menunjukkan profil tenaga. X menunjukkan penghasilan ammonia melalui Proses Haber.

Diagram 7 shows the energy profile diagram. X shows the production of ammonia through Haber Process.



Rajah 7 / Diagram 7

Apakah perubahan yang perlu dilakukan untuk mendapatkan lengkung Y?

What is the change needed to be done to obtain curve Y?

- A Panaskan bahan tindak balas pada 450 °C.
Heat the reactants at 450 °C.
- B Mampatkan bahan tindak balas pada tekanan 1 atm.
Compress the reactants at 1 atm.
- C Tingkatkan kepekatan bahan tindak balas.
Increase the concentration of reactants.
- D Panaskan bahan tindak balas dengan kehadiran besi.
Heat the reactants in the presence of iron.

3 | Jadual 3 menunjukkan maklumat tentang eksperimen yang dijalankan untuk mengkaji kadar tindak balas antara zink dengan asid hidroklorik.

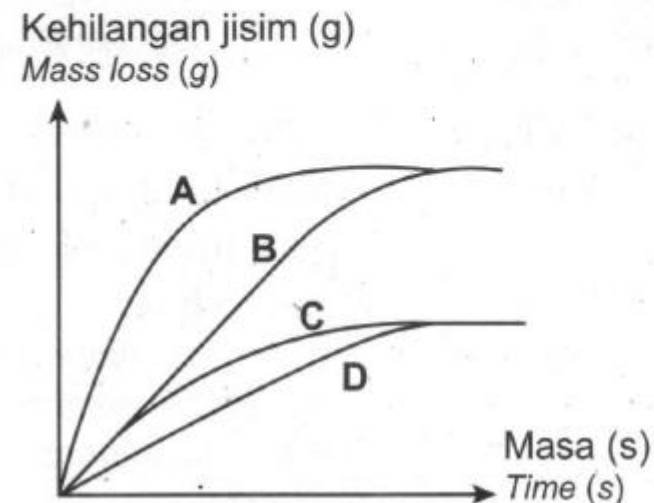
Table 3 shows information about the experiments carried out to study the rate of reaction between zinc and hydrochloric acid.

Eksperimen <i>Experiment</i>	Kepekatan asid hidroklorik (mol dm⁻³) <i>Concentration of hydrochloric acid</i> <i>(mol dm⁻³)</i>	Saiz zink <i>Size of zinc</i>	Suhu (°C) <i>Temperature (°C)</i>
I	1.0	Besar <i>Large</i>	30
II	1.0	Kecil <i>Small</i>	30
III	0.5	Besar <i>Large</i>	30
IV	0.5	Kecil <i>Small</i>	30

Jadual 3 / Table 3

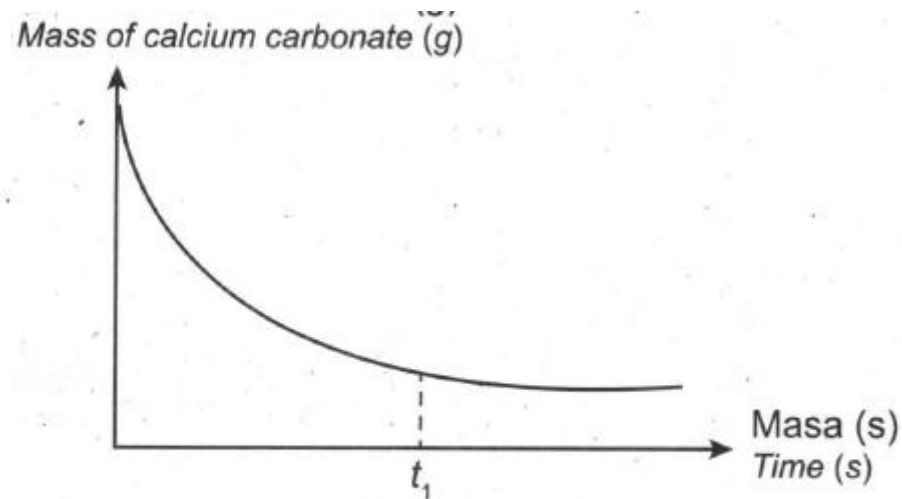
Antara lengkungan graf berikut, yang manakah menunjukkan kehilangan jisim dalam Eksperimen III?

Which of the following curve of the graph shows the correct mass loss in Experiment III.



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32. Diagram 6.1 shows the graph of the mass of calcium carbonate against time for the reaction between calcium carbonate and hydrochloric acid. 3.00 g of calcium carbonate is added into 100 cm³ of 0.2 mol dm⁻³ hydrochloric acid to study the rate of reaction at 30°C.



Rajah 6.1 / Diagram 6.1

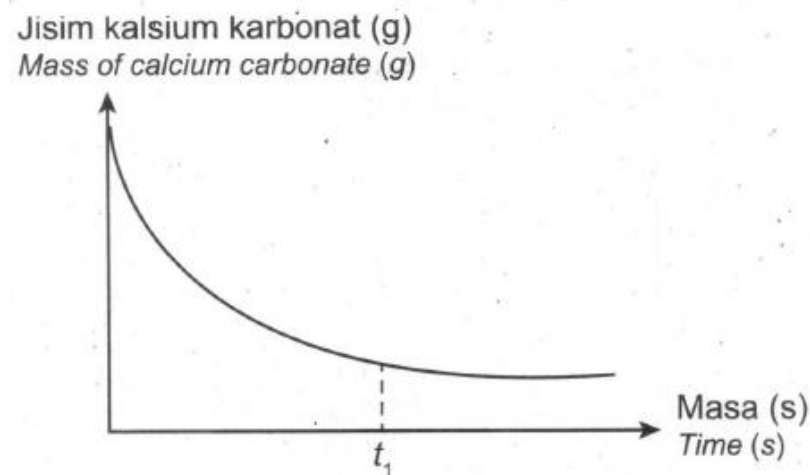
(a) Based on Diagram 6.1, why is the curve in the graph remains constant after t_1 second?[1]

(b) Calculate the volume of gas produced at room condition. [Molar volume of gas = 24 dm³mol⁻¹ at room condition][2]

(c) Determine the mass of unreacted calcium carbonate in this experiment. [Relative atomic mass:Ca = 40, C = 12, O=16] [2]

(d) The experiment is repeated at the temperature of 40 °C with the other factors remain unchanged.

(i) Sketch the curve obtained for this experiment on the same axis in Diagram 6.2.[1]



(ii) Based on your answer in 6(d)(i), explain how the temperature affect the rate of reaction by using collision theory. [3]

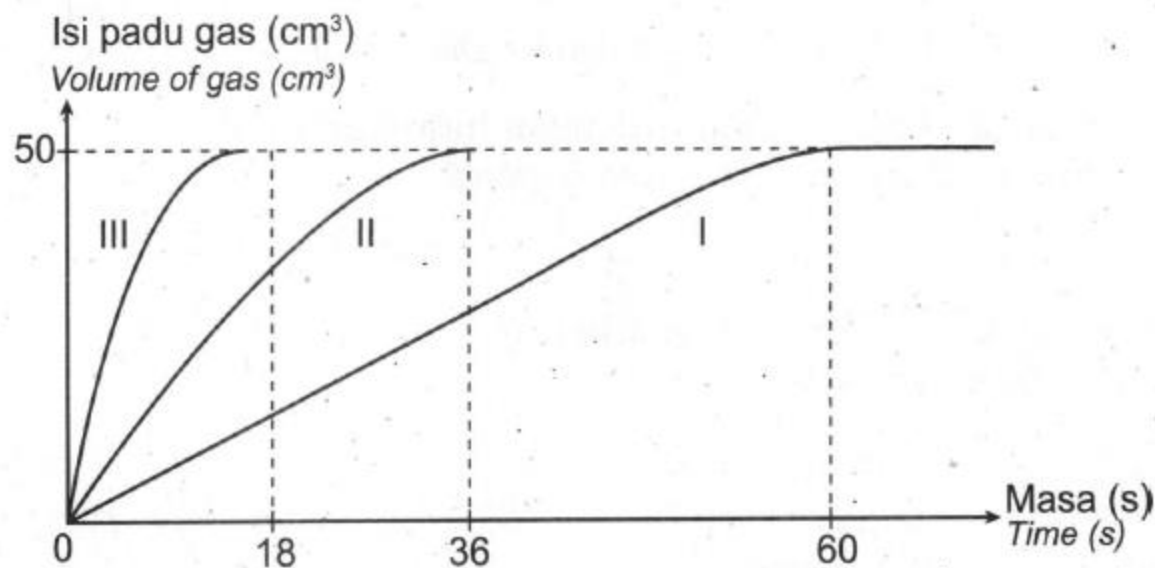
Brought to you by:

33. A group of pupils carried out three experiments to investigate the factors affecting the rate of reaction. Table 2 shows the information about the reaction in each experiment.

Eksperimen <i>Experiment</i>	Bahan tindak balas <i>Reactants</i>
I	50 cm ³ asid sulfurik 1.0 mol dm ⁻³ + serbuk zink <i>50 cm³ of 1.0 mol dm⁻³ sulphuric acid + zinc powder</i>
II	50 cm ³ asid sulfurik 2.0 mol dm ⁻³ + serbuk zink <i>50 cm³ of 2.0 mol dm⁻³ sulphuric acid + zinc powder</i>
III	50 cm ³ asid sulfurik asid 2.0 mol dm ⁻³ + serbuk zink + kuprum(II) sulfat <i>50 cm³ of 2.0 mol dm⁻³ sulphuric acid + zinc powder + copper(II) sulphate</i>

(a) Calculate the overage rate of reaction for Experiment I. [2]

Diagram 8 shows a part of the results of these experiments



(b) Sketch the energy profile diagram for Experiment II and Experiment III on the same axes. Indicate clearly the activation energy for each experiment.[4]

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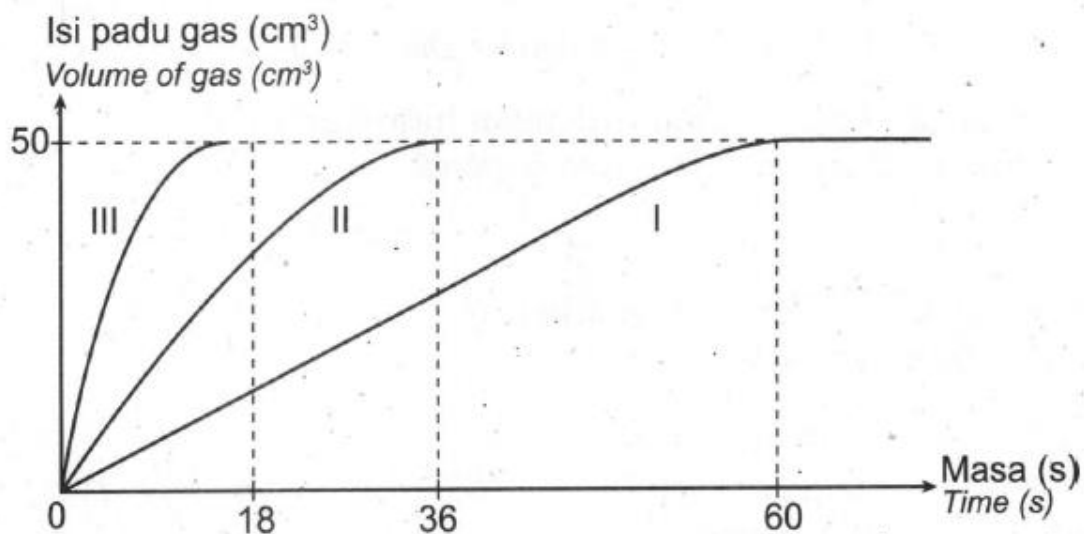
A group of pupils carried out three experiments to investigate the factors affecting the rate of reaction. Table 2 shows the information about the reaction in each experiment.

Eksperimen <i>Experiment</i>	Bahan tindak balas <i>Reactants</i>
I	50 cm ³ asid sulfurik 1.0 mol dm ⁻³ + serbuk zink <i>50 cm³ of 1.0 mol dm⁻³ sulphuric acid + zinc powder</i>
II	50 cm ³ asid sulfurik 2.0 mol dm ⁻³ + serbuk zink <i>50 cm³ of 2.0 mol dm⁻³ sulphuric acid + zinc powder</i>
III	50 cm ³ asid sulfurik asid 2.0 mol dm ⁻³ + serbuk zink + kuprum(II) sulfat <i>50 cm³ of 2.0 mol dm⁻³ sulphuric acid + zinc powder + copper(II) sulphate</i>

(c) Based on Table 2 and Diagram 8, compare the rate of reaction between Experiment I and Experiment II

Explain the difference of rate of reaction in each case by referring to the collision theory.
[10]

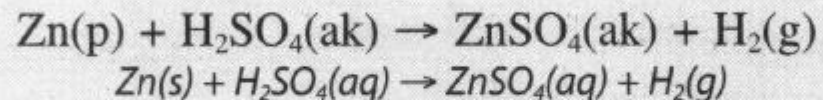
Diagram 8 shows a part of the results of these experiments



Brought to you by:

- (d) Persamaan kimia di bawah menunjukkan tindak balas antara asid sulfurik dengan serbuk zink dalam Eksperimen II.

The chemical equation below shows the reaction between sulphuric acid and zinc powder in Experiment II.



Hitung isi padu maksimum gas hidrogen yang terhasil dalam Eksperimen II.

[Isi padu molar gas = $24 \text{ dm}^3 \text{ mol}^{-1}$ pada keadaan bilik]

Calculate the maximum volume of hydrogen gas produced in Experiment II.

[Molar volume of gas = $24 \text{ dm}^3 \text{ mol}^{-1}$ at room condition]

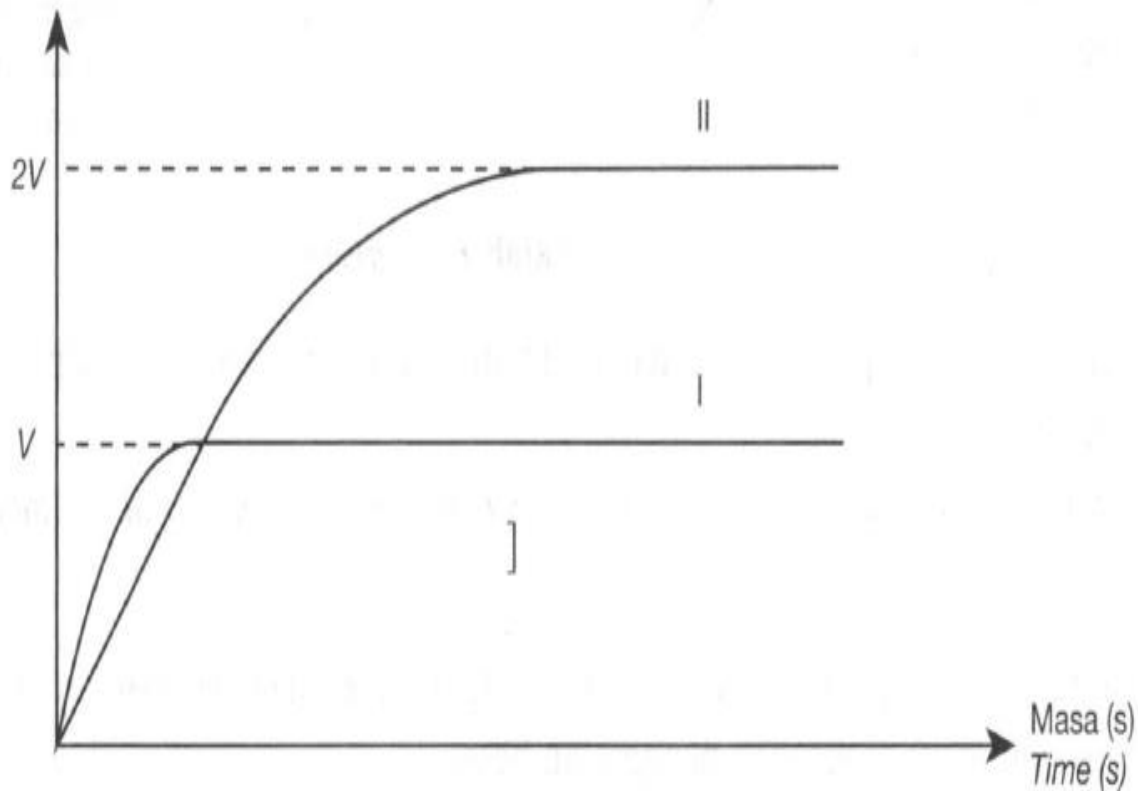
Eksperimen <i>Experiment</i>	Bahan tindak balas <i>Reactants</i>
I	50 cm ³ asid sulfurik 1.0 mol dm ⁻³ + serbuk zink <i>50 cm³ of 1.0 mol dm⁻³ sulphuric acid + zinc powder</i>
II	50 cm ³ asid sulfurik 2.0 mol dm ⁻³ + serbuk zink <i>50 cm³ of 2.0 mol dm⁻³ sulphuric acid + zinc powder</i>
III	50 cm ³ asid sulfurik 2.0 mol dm ⁻³ + serbuk zink + kuprum(II) sulfat <i>50 cm³ of 2.0 mol dm⁻³ sulphuric acid + zinc powder + copper(II) sulphate</i>

[4 markah / 4 marks]

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34. Diagram 8 below shows curve I and curve II obtained from an experiment where zinc is reacted with sulphuric acid at the same temperature.

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



Curve I is obtained from the reaction between excess zinc powder with 25cm^3 of 0.2mol dm^{-3} sulphuric acid.

(i) Suggest the changes that have been made to get curve II. Justify your answer [5]

(ii) The experiment is repeated by replacing hydrochloric acid with 50cm^3 of 0.5mol dm^{-3} sulphuric acid. Explain the changes in the rate of reaction and the maximum volume of gas collected. [3]

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