

CHAPTER 4: THERMOCHEMISTRY**BAB 4 : TERMOKIMIA****SOALAN OBJEKTIF**

- 1 Table 1 shows the heat of displacement, ΔH of copper by zinc and magnesium.
Jadual 1 menunjukkan haba penyesaran, ΔH kuprum oleh zink dan magnesium.

Set	Reactants/ <i>Bahan tindak balas</i>	ΔH , kJ mol^{-1}
I	Zinc + copper(II) sulphate solution <i>Zink + larutan kuprum(II) sulfat</i>	-210
II	Magnesium + copper(II) sulphate solution <i>Magnesium + larutan kuprum(II) sulfat</i>	-218

Table 1/ *Jadual 1*

Which statement best explain the difference of heats of displacement?

Penyataan manakah yang paling baik menerangkan perbezaan haba penyesaran?

- A The temperature rise higher in set II
Kenaikan suhu set II lebih tinggi
- B Zinc is more electropositive than magnesium
Zink lebih elektropositif berbanding magnesium
- C The energy content of reactants in set I is high
Kandungan tenaga di dalam bahan tindak balas dalam set I adalah tinggi
- D Distance between magnesium and copper in the electrochemical series is further
Jarak antara magnesium dengan kuprum di dalam siri elektrokimia adalah lebih jauh
- 2 A group of students carried out two sets of an experiment to study the heat of neutralisation between nitric acid and different alkali. Table 2 shows the heat of neutralisation of the experiment.

Sekumpulan murid menjalankan dua set eksperimen untuk mengkaji haba peneutralan antara asid nitrik dengan alkali yang berbeza. Jadual 2 menunjukkan haba peneutralan bagi eksperimen itu.

Set	Reactants/ <i>Bahan tindak balas</i>	ΔH , kJ mol ⁻¹
I	Nitric acid and ammonia solution <i>Asid nitrik dan larutan ammonia</i>	-55
II	Nitric acid and sodium hydroxide solution <i>Asid nitrik dan larutan natrium hidroksida</i>	-57

Table 2/ *Jadual 2*

Which statement best explain the difference of heats of neutralisation?

Penyataan manakah yang paling baik menerangkan perbezaan haba peneutralan?

- A** Ammonia solution is a weak alkali
Larutan ammonia ialah alkali lemah
- B** Ammonia ionises partially in water
Ammonia mengion secara separa di dalam air
- C** Ammonia molecules reabsorb some of the heat energy released to complete its ionisation in water
Molekul ammonia menyerap semula sebahagian tenaga haba yang dibebaskan untuk melengkapkan pengionannya di dalam air
- D** The heat absorbed to break bonds in the reactants is higher than the heat released during bond formation
Haba yang diserap untuk memutuskan ikatan dalam bahan tindak balas lebih tinggi berbanding dengan haba yang dibebaskan semasa pembentukan ikatan

- 3** In an experiment, 50 cm³ of 1.0 mol dm⁻³ lead(II) nitrate solution is added to the 50 cm³ of 2.0 mol dm⁻³ copper(II) chloride solution in a plastic container. The temperature of the mixture rises by 1.5 °C. What is the heat of precipitation? [Density of water = 1.0 g cm⁻³; Specific heat capacity of solution = 4.2 J g⁻¹°C⁻¹]

Dalam satu eksperimen, 50 cm³ larutan plumbum(II) nitrat 1.0 mol dm⁻³ di tambah kepada 50 cm³ larutan kuprum(II) klorida 2.0 mol dm⁻³ di dalam sebuah bekas plastik. Suhu campuran telah meningkat sebanyak 1.5 °C. Berapakah haba pemendakan eksperimen ini?

[Ketumpatan air = 1.0 g cm^{-3} ; Muatan haba tentu larutan = $4.2 \text{ J g}^{-1}\text{C}^{-1}$]

- A $+6.3 \text{ kJ mol}^{-1}$
- B -6.3 kJ mol^{-1}
- C $+12.6 \text{ kJ mol}^{-1}$
- D $-12.6 \text{ kJ mol}^{-1}$

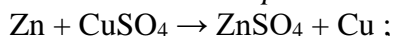
- 4 When solid potassium nitrate is added to water, the temperature of the liquid falls. What can be concluded from this observation?

Apabila pepejal kalium nitrat dicampur dengan air, suhu cecair menurun. Apakah kesimpulan yang boleh dibuat daripada pemerhatian ini?

- A Some of the solid potassium nitrate dissolves in water
Sebahagian daripada pepejal kalium nitrat larut dalam air
- B The potassium nitrate ionizes in water
Kalium nitrate mengion dalam air
- C The process releases heat to surroundings
Proses ini membebaskan haba ke persekitaran
- D The process is endothermic
Proses ini adalah endotermik

- 5 The following is a thermochemical equation.

Berikut ialah suatu persamaan termokimia.



$$\Delta H = -190 \text{ kJmol}^{-1}$$

What is the heat change when 4.8 g of copper is formed in this reaction?

Berapakah perubahan haba apabila 4.8 g kuprum terbentuk dalam tindak balas ini?

[Relative atomic mass : Cu = 64]

[Jisim atom relatif : Cu = 64]

- | | |
|----------|-----------|
| A 4750 J | C 14250 J |
| B 9500 J | D 28500 J |

- 6 The heat of combustion of 1 mole of ethanol is $-1371 \text{ kJ mol}^{-1}$. The chemical reaction is given in the equation below.

Haba pembakaran bagi 1 mol etanol adalah $-1371 \text{ kJ mol}^{-1}$. Tindak balas kimia ditunjukkan seperti persamaan di bawah.



If 0.1 mol of ethanol is burnt in excess oxygen, how much heat is released?

Jika 0.1 mol etanol dibakar dalam oksigen berlebihan, berapakah tenaga haba yang dibebaskan?

- | | | | |
|---|----------|---|----------|
| A | 1.371 kJ | C | 137.1 kJ |
| B | 13.71 kJ | D | 13710 kJ |

- 7 Diagram 1 shows the thermometer readings when excess magnesium powder is added to 50 cm^3 of 0.5 mol dm^{-3} Copper(II) chloride solution in a polystyrene cup.

Rajah 1 menunjukkan bacaan termometer apabila serbuk magnesium berlebihan ditambah kepada 50 cm^3 larutan kuprum(II) klorida 0.5 mol dm^{-3} dalam cawan polisterina.

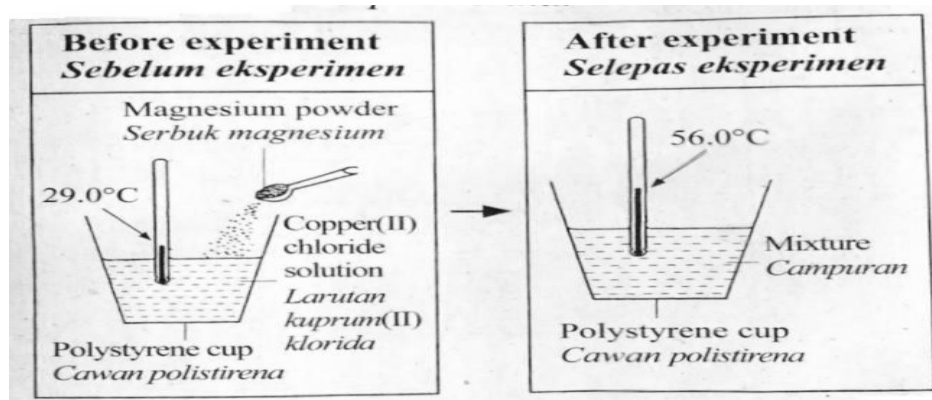


Diagram 1/Rajah 1

What is the heat of displacement for the reaction?

[Specific heat capacity of water = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$; Density of water = 1.0 gdm^{-3}]

Berapakah haba penyesaran bagi tindak balas itu?

[Muatan haba tentu air = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$; Ketumpatan air = 1.0 gdm^{-3}]

- A $-226.8 \text{ kJ mol}^{-1}$ C $-470.4 \text{ kJ mol}^{-1}$
 B $-243.6 \text{ kJ mol}^{-1}$ D $-5\,670.0 \text{ kJ mol}^{-1}$

- 8 The heat of combustion for propanol, $\text{C}_3\text{H}_7\text{OH}$ is $-2016 \text{ kJ mol}^{-1}$. When 0.3 g of propanol is completely burnt, the heat given out is used to heat 250 cm^3 of water. What is the rise in temperature for the water?
 [Specific heat capacity of water = $4.2 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$ Molar mass of propanol = 60 g mol^{-1}]
Haba pembakaran propanol, $\text{C}_3\text{H}_7\text{OH}$ adalah $-2016 \text{ kJ mol}^{-1}$. Apabila 0.3 g propanol terbakar lengkap, haba yang dibebaskan digunakan untuk memanaskan 250 cm^3 air. Apakah kenaikan suhu air?

[Muatan haba tentu air = $4.2 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$ Jisim molar propanol = 60 g mol^{-1}]

- A $2.4 \text{ } ^\circ\text{C}$ C $9.6 \text{ } ^\circ\text{C}$
 B $4.8 \text{ } ^\circ\text{C}$ D $19.2 \text{ } ^\circ\text{C}$
- 9 Diagram 2 shows the set-up of apparatus to determine the heat of precipitation of barium sulphate.
Rajah 2 menunjukkan susunan radas untuk menentukan haba pemendakan bagi barium sulfat.

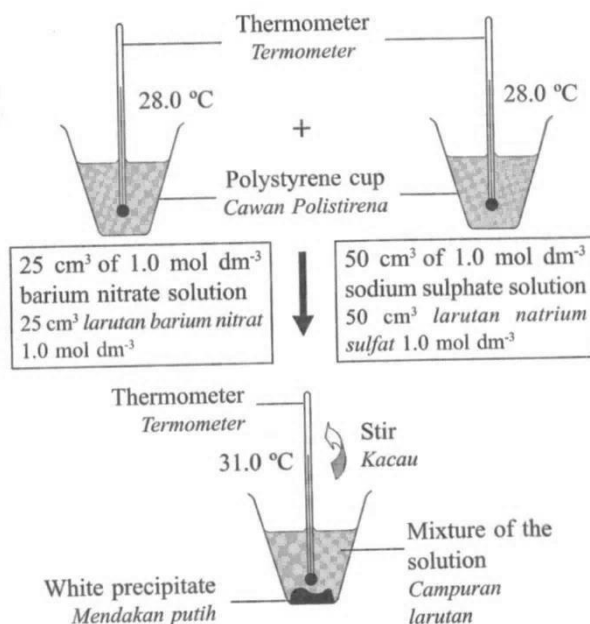


Diagram 2/Rajah 2

What is the heat of precipitation of barium sulphate?

Berapakah haba pemendakan bagi barium sulfat?

[Specific heat capacity of solution = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$; Density of solution = 1.0 gdm^{-3}]

[Muatan haba tentu larutan = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$, Ketumpatan larutan = 1.0 gdm^{-3}]

A 18.9 kJ mol^{-1}

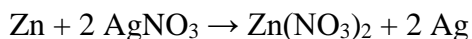
C $18900 \text{ kJ mol}^{-1}$

B 37.8 kJ mol^{-1}

D $37800 \text{ kJ mol}^{-1}$

- 10 The following thermochemical equation represents the displacement of silver by zinc.

Persamaan termokimia berikut mewakili penyesaran argentum oleh zink.



$$\Delta H = -360 \text{ kJ mol}^{-1}$$

What is the mass of zinc required to release 60.0 kJ of heat?

[Relative atomic mass: Zn = 65]

Apakah jisim zink yang diperlukan untuk membebaskan 60.0 kJ haba?

[Jisim atom relatif: Zn = 65]

A 6.0 g

C 10.8 g

B 8.1 g

D 18.0 g

- 11 Temperature of water rises by $30.0 \text{ }^{\circ}\text{C}$ when 0.92 g of propanol is used to heat 200 cm^3 of water. What is the heat released in the reaction? [Specific heat capacity of solution = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$; Density of solution = 1.0 gdm^{-3}]

Suhu air meningkat sebanyak 30°C apabila 0.92 g propanol digunakan untuk memanaskan 200 cm^3 air

Berapakah nilai haba yang dibebaskan di dalam tindak balas tersebut?

[Muatan haba tentu larutan = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$, Ketumpatan larutan = 1.0 gdm^{-3}]

A 115.92J

C 25200 J

B 5796 J

D 1260000 J

- 12 When 100 cm³ of 1.0 mol dm⁻³ hydrochloric acid reacts with 100 cm³ of 1.0 mol dm⁻³ potassium hydrogen carbonate solution, the temperature decreased by 8°C.

What is the decrease in temperature for the reaction when 50 cm³ of 1.0 mol dm⁻³ hydrochloric acid reacts with 50 cm³ of 1.0 mol dm⁻³ potassium hydrogen carbonate solution?

Apabila 100 cm³ asid hidroklorik 1.0 mol dm⁻³ bertindak balas dengan 100 cm³ larutan kalium hidrogen karbonat 1.0 mol dm⁻³ suhu berkurang sebanyak 8 °C.

Berapakah penurunan suhu bagi tindak balas apabila 50 cm³ asid hidroklorik 1.0 mol dm⁻³ bertindak balas dengan 50 cm³ larutan kalium hidrogen karbonat 1.0 mol dm⁻³?

- | | | | |
|---|--------|---|--------|
| A | 0.18°C | C | 8.0°C |
| B | 0.58°C | D | 28.0°C |

- 13 Which of the following acids releases the largest amount of heat energy when 1 mol of acid reacts with excess sodium hydroxide solution?

Antara asid berikut, yang manakah membebaskan tenaga haba paling tinggi apabila 1 mol asid bertindak balas dengan larutan natrium hidroksida berlebihan?

- A Nitric acid
Asid nitrik
- B Ethanoic acid
Asid etanoik
- C Sulphuric acid
Asid sulfurik
- D Hydrochloric acid
Asid hidroklorik

- 14 The fuel value of methanol is 23 kJ g⁻¹, Which statement is true,
[Relative atomic mass: H = 1, C = 12, O = 16]

*Nilai bahan api bagi metanol ialah 23 kJ g⁻¹. Pernyataan yang manakah benar?
Jisim atom relatif: H = 1, C = 12, O = 16]*

- A 1 mol of methanol releases 23 kJ of heat

1 mol metanol membebaskan 23 kJ haba

- B** 1 gram of metanol releases 23 kJ of heat
1 gram metanol membebaskan 23 kJ haba
- C** The heat of combustion of methanol is 23 kJ mol^{-1}
Haba pembakaran metanol ialah 23 kJ mol^{-1}
- D** 1 gram of oxygen is needed to burn 23 g of methanol
1 gram oksigen diperlukan untuk membakar 23 g metanol

- 15** Diagram 3 shows an energy level diagram.
Rajah 3 menunjukkan satu gambar rajah aras tenaga.

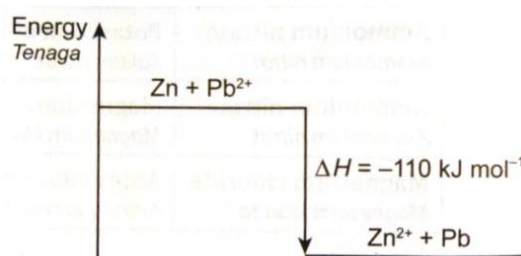


Diagram 3/Rajah 3

Excess zinc powder is added to 50 cm^3 of 0.2 mol dm^{-3} Lead (II) salt solution.
Calculate the increase in temperature of the solution.

Serbuk zink berlebihan ditambah kepada 50 cm^3 larutan garam plumbum(II) 0.2 moldm^{-3} .

Hitungkan kenaikan suhu larutan.

[Specific heat capacity of solution = $4.2 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$; Density of solution = 1.0 gdm^{-3}]

[Muatan haba tentu larutan = $4.2 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$, Ketumpatan larutan = 1.0 gdm^{-3}]

- | | |
|------------------------------|-------------------------------|
| A 1.3°C | C 5.2°C |
| B 2.6°C | D 10.4°C |

- 16 Diagram 4 shows the results obtained when metal X is added into copper(II) sulphate solution.

Rajah 4 menunjukkan keputusan yang diperoleh apabila logam X ditambah ke dalam larutan kuprum(II) sulfat.

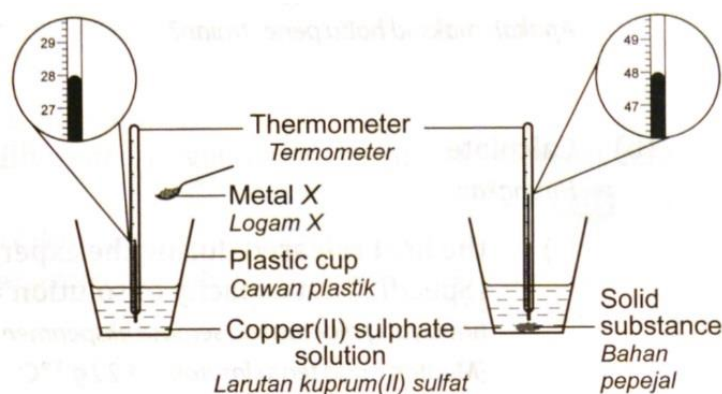


Diagram 4/Rajah 4

Which of the following explains the reaction?

Antara berikut, yang manakah menjelaskan tindak balas tersebut?

- A Precipitation reaction and exothermic
Tindak balas pemendakan dan eksotermik
- B Precipitation reaction and endothermic
Tindak balas pemendakan dan endotermik
- C Displacement reaction and exothermic
Tindak balas penyesaran dan eksotermik
- D Displacement reaction and endothermic
Tindak balas penyesaran dan endotermik
- 17 When 50 cm³ of Potassium carbonate solution, K₂CO₃ is added into of 50 cm³ calcium nitrate solution, Ca(NO₃)₂. 840 J of heat is released.
Calculate the temperature change.

*Apabila 50 cm³ larutan kalium karbonat, K₂CO₃ ditambah ke dalam 50 cm³ larutan kalsium nitrat, Ca(NO₃)₂. 840 J haba dibebaskan.
Kira perubahan suhu.*

[Specific heat capacity of solution = 4.2 J g⁻¹ °C⁻¹; Density of solution = 1.0 gdm⁻³]
[Muatan haba tentu larutan = 4.2 J g⁻¹ °C⁻¹, Ketumpatan larutan = 1.0 gdm⁻³]

- | | | | |
|----------|-----|----------|------|
| A | 2°C | C | 4°C |
| B | 3°C | D | 5 °C |

- 18** 50 cm³ of 1.0 mol dm⁻³ Sodium hydroxide solution is added into 50 cm³ of 1.0 mol dm⁻³ hydrochloric acid. The temperature change is a°C. What is the temperature change if the concentration of both solutions is reduced to 0.5 mol dm⁻³ while other conditions remain the same?

50cm³ larutan natrium hidroksida 1.0 mol dm⁻³ ditambah ke dalam 50cm³ asid hidroklorik 1.0 mol dm⁻³. Peningkatan suhu ialah sebanyak a°C. Berapakah perubahan suhu jika kepekatan kedua-dua larutan dikurangkan kepada 0.5 mol dm⁻³ manakala keadaan lain dikekalkan.

- | | | | |
|----------|-------|----------|------------------------|
| A | 2a °C | C | $\frac{a^{\circ}C}{2}$ |
| B | a °C | D | $\frac{a^{\circ}C}{4}$ |

- 19** Which of following is an example of exothermic reaction?

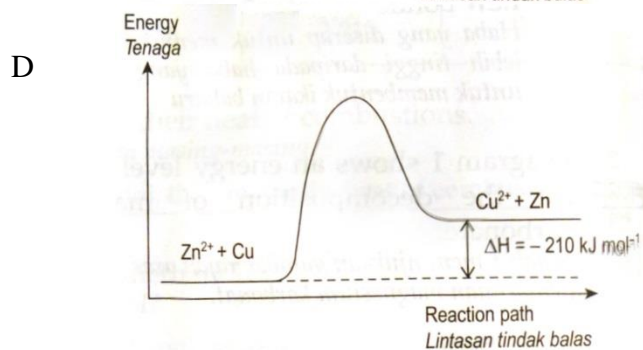
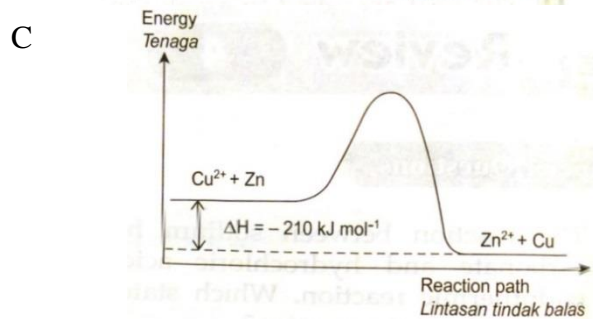
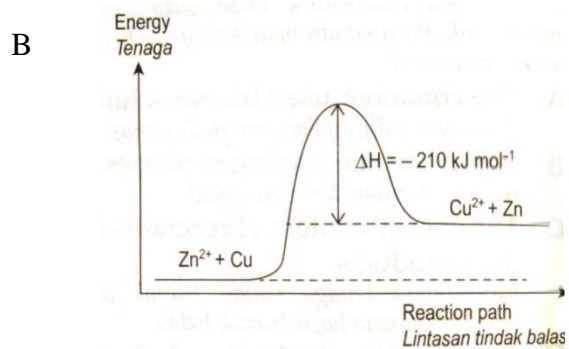
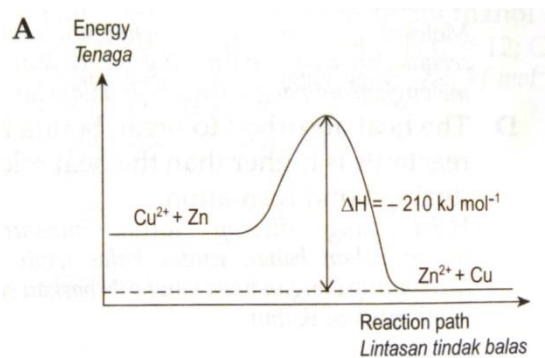
Antara yang berikut, yang manakah contoh tindak balas eksotermik?

- A** Dissolving potassium hydroxide in water
Melarutkan kalium hidroksida dalam air
- B** Dissolving ammonium nitrate salt in water
Melarutkan garam ammonium nitrat dalam air
- C** Decomposition of zinc nitrate salt when heated
Penguraian garam zink nitrat apabila dipanaskan
- D** Decomposition of hydrated copper(II) sulphate salt to anhydrous copper(II) sulphate salt and water when heated
Penguraian garam kuprum(II) sulfat terhidrat kepada garam kuprum(II) sulfat kontang dan air apabila dipanaskan

- 20** The heat of displacement of copper by zinc from copper(II) sulphate is -210 kJ mol⁻¹. Which energy profile diagram represents the reaction?

Haba penyesaran logam kuprum oleh zink daripada larutan kuprum(II)sulfat ialah -210 kJ mol⁻¹,

Gambar rajah profil tenaga manakah yang mewakili tindak balas itu?



- 21** A group of students carried out two sets of an experiment to study the heat of neutralisation between nitric acid and different alkali. Table 3 shows the heat of neutralisation of the experiment.
- Sekumpulan murid menjalankan dua set eksperimen untuk mengkaji haba peneutralan antara asid nitrik dengan alkali yang berbeza. Jadual 3 menunjukkan haba peneutralan bagi eksperimen itu.*

Reactants <i>Bahan tindak balas</i>	Heat of neutralisation <i>Haba peneutralan [kJ mol⁻¹]</i>
Nitric acid and sodium hydroxide solution <i>Asid nitrik dan larutan natrium hidroksida</i>	-55.0
Nitric acid and ammonia solution <i>Asid nitrik dan larutan ammonia</i>	-57.0

Table 3/Jadual 3

Which statement is the best to explain the difference in the heat of neutralisation?
Pernyataan manakah yang terbaik menerangkan perbezaan bagi haba peneutralan itu?

- A** Ammonia solution is a weak alkali
Larutan ammonia ialah alkali lemah
- B** Ammonia ionises partially in water
Ammonia mengion secara separa di dalam air
- C** Ammonia molecules reabsorbed some of the heat energy released to complete its ionisation in water
Molekul ammonia menyerap semula sebahagian tenaga haba yang dibebaskan untuk melengkapkan pengionannya di dalam air
- D** The heat absorbed to break bonds in the reactants is higher than the heat released during bond formation
Haba yang diserap untuk memutuskan ikatan dalam bahan tindak balas lebih tinggi berbanding dengan haba yang dibebaskan semasa pembentukan ikatan

- 22** Heat of combustion of butan-1-ol is higher than heat of combustion of propan-1-ol
Haba pembakaran butan-1-ol lebih besar daripada haba pembakaran propan-1-ol

Which statement is the best to explain the difference in the heat of combustion?

Pernyataan manakah yang terbaik menerangkan perbezaan haba pembakaran itu?

- A** Some heat is lost to surroundings
Sebahagian haba hilang ke persekitaran
- B** Molecular size of butan-1-ol is greater than that of propan-1-ol
Saiz molekul butan-1-ol lebih besar daripada saiz molekul propan-1-ol
- C** Butan-1-ol generates greater number of moles of carbon dioxide gas
Butan-1-ol menghasilkan lebih banyak bilangan mol gas karbon dioksida
- D** The number of propan-1-ol molecules that does not burnt completely is greater than butan-1-ol
Bilangan molekul propan-1-ol yang tidak terbakar dengan lengkap lebih banyak daripada butan-1-ol

- 23** Diagram 5 shows the energy level diagram for the combustion of methanol, CH_3OH .
Rajah 5 menunjukkan gambarajah aras tenaga bagi pembakaran metanol, CH_3OH .

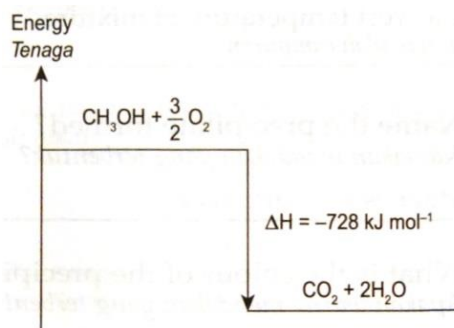


Diagram 5

Rajah 5

What is the mass of methanol needed to raise the temperature of 200 cm^3 of water by 30.5°C ?

Berapakah jisim metanol yang diperlukan untuk menaikkan suhu 200 cm^3 air sebanyak 30.5°C ?

[Molar mass of CH_3OH = 32; Specific heat capacity of solution = $4.2 \text{ J g}^{-1} ^\circ\text{C}^{-1}$; Density of solution = 1.0 g dm^{-3}]

[Jisim molar CH_3OH = 32 Muatan haba tentu larutan = $4.2 \text{ J g}^{-1} ^\circ\text{C}^{-1}$, Ketumpatan larutan = 1.0 g dm^{-3}]

- | | | | |
|----------|--------|----------|---------|
| A | 1.12 g | C | 28.42 g |
| B | 2.24 g | D | 35.19 g |

- 24 The heat of combustion obtained from an experiment is normally less than the theoretical value.
Which precaution step can be taken to increase the accuracy of the result?
Haba pembakaran yang diperolehi daripada eksperimen biasanya kurang daripada nilai teori.
Langkah berjaga-jaga manakah yang boleh diambil untuk meningkatkan ketepatan keputusan?
- A Weigh the spirit lamp when the flame is almost put out
Timbang lampu pelita apabila api hampir terpadam
 - B Stir the water periodically during the experiment
Kacau air secara berkala semasa eksperimen
 - C Used a wire gauze to prevent direct heating
Menggunakan kasa dawai untuk mengelakkan pemanasan secara langsung
 - D Use a thin copper can
Gunakan tin kuprum yang nipis

25



A milkshake is prepared by adding 50.0 cm^3 of orange juice to 250.0 cm^3 of fresh milk. It is found that the temperature of the milkshake increases by 3.0°C . What is the total amount of heat change?

Susu kocak disediakan dengan menambahkan 50.0 cm^3 jus oren kepada 250.0 cm^3 susu segar. Didapati bahawa suhu susu kocak meningkat sebanyak 3.0°C . Apakah jumlah perubahan haba?

[Specific heat capacity of milkshake = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$; Density of solution = 1.0 gdm^{-3}]
 [Muatan haba tentu susu kocak = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$, Ketumpatan larutan = 1.0 gdm^{-3}]

- A 250 J
- B 300 J
- C 750 J
- D 900 J

- 26 Four mixtures, A, B, C and D were obtained by mixing sodium hydroxide with hydrochloric acid of the same concentration. Which of the following mixtures will produce the greatest temperature change when mixed?

Empat campuran A, B, C dan D telah diperolehi daripada campurnan natrium hidroksida dengan asid hidroklorik yang sama kepekatan. Antara campuran yang berikut, yang manakah akan menghasilkan perubahan suhu yang terbesar apabila dicampurkan?

	Volume of NaOH/cm ³ <i>Isi padu NaOH/cm³</i>	Volume of HCl /cm ³ <i>Isi padu HCl /cm³</i>
A	10	40
B	20	30
C	30	40
D	30	30

- 27 Diagram 6 shows a graph of heat of combustion of alcohol against number of carbon atoms per molecule.

Rajah 6 menunjukkan graf haba pembakaran alkohol melawan nombor atom karbon per molekul.

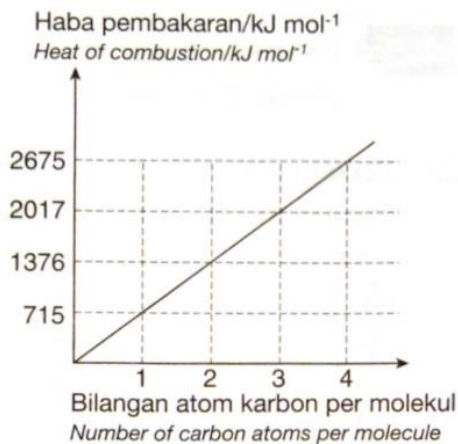


Diagram 6

Rajah 6

How much heat is released when 23 g of ethanol is burned?

Berapakah haba yang dibebaskan apabila 23 g etanol dibakar?

[Relative atomic mass: C, 12; H, 1]

[Iisim atom relatif C, 12; H, 1]

A 68.8 kJ

B 137.6 kJ

C 688 kJ

D 1376 kJ

- 28 A drink is prepared by adding 10 cm³ of lime juice and 30 cm³ fruit juice into 150 cm³ of water. After mixing, the temperature of the drink is found to increase by 2.0°C. Calculate the heat released.

[Specific heat capacity of drink: $S \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$; Density of solution: 1 g cm^{-3}]

Satu minuman disediakan dengan mencampurkan 10 cm³ jus limau dan 30 cm³ jus buah-buahan ke dalam 150 cm³ air. Selepas dicampurkan, suhu minuman tersebut meningkat sebanyak 2.0 °C.

Hitungkan haba yang dibebaskan.

[haba muatan tentu minuman: $S \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$; Ketumpatan larutan: 1 g cm^{-3}]

- A 180S J
 B 270S J
 C 380S J
 D 570S J

- 29 An experiment is carried out to determine the quantity of heat given out when 80 cm^3 of 0.5 mol dm^{-3} barium chloride solution reacts with 80 cm^3 of 0.5 mol dm^{-3} potassium sulphate solution. Which of the following pairs of solutions *H* and *G* will produce the same quantity of heat, as obtained in the experiment, when they are mixed?

*Satu eksperimen dijalankan untuk menentukan kuantiti haba yang dibebaskan apabila 80 cm^3 larutan barium klorida 0.5 mol dm^{-3} bertindak balas dengan 80 cm^3 larutan kalium sulfat 0.5 mol dm^{-3} . Manakah pasangan larutan *H* dan *G* berikut akan menghasilkan kuantiti haba yang sama seperti yang diperolehi daripada eksperimen, apabila larutan ini dicampurkan?*

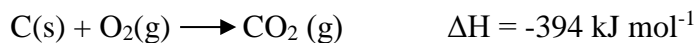
	Solution <i>H</i> <i>Larutan H</i>	Solution <i>G</i> <i>Larutan G</i>
I	80 cm^3 of 0.5 mol dm^{-3} barium nitrate solution <i>80 cm^3 larutan barium nitrat 0.5 mol dm^{-3}</i>	80 cm^3 of 0.5 mol dm^{-3} sulphuric acid <i>80 cm^3 asid sulfurik 0.5 mol dm^{-3}</i>
II	80 cm^3 of 0.5 mol dm^{-3} zinc chloride solution <i>80 cm^3 larutan zink klorida 0.5 mol dm^{-3}</i>	80 cm^3 of 0.5 mol dm^{-3} sodium nitrate solution <i>80 cm^3 larutan natrium nitrat 0.5 mol dm^{-3}</i>
III	80 cm^3 of 0.5 mol dm^{-3} hydrochloric acid <i>80 cm^3 asid hidroklorik 0.5 mol dm^{-3}</i>	80 cm^3 of 0.5 mol dm^{-3} sodium sulphate solution <i>80 cm^3 larutan natrium sulfat 0.5 mol dm^{-3}</i>
IV	80 cm^3 of 0.5 mol dm^{-3} barium chloride solution <i>80 cm^3 larutan barium klorida 0.5 mol dm^{-3}</i>	80 cm^3 of 0.5 mol dm^{-3} magnesium sulphate solution <i>80 cm^3 larutan magnesium sulfat 0.5 mol dm^{-3}</i>

- A IV only

- B I and IV only
- C II and III only
- D I, II and III only

30 Carbon burns in oxygen in a reaction as shown in the equation below.

Karbon terbakar dalam oksigen seperti ditunjukkan dalam persamaan dibawah



What is the mass of carbon that must be burnt completely to produce 78.8 kJ of heat?

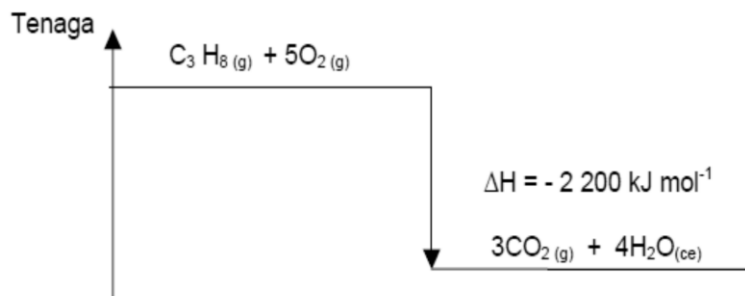
[Relative atomic mass: C,12]

Berapakah jisim karbon yang mesti terbakar untuk menghasilkan 78.8 kJ haba?

[Jisim atom relatif: C,12]

- | | | | |
|---|-------|---|-------|
| A | 0.2 g | C | 2.4 g |
| B | 1.2 g | D | 5.0 g |

31



What is the mass of propane burnt to release 100 kJ of heat?

[Relative atomic mass: H = 1; C = 12]

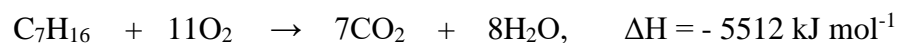
Berapakah jisim propana yang perlu dibakar untuk membebaskan 100 kJ haba?

[Jisim atom relatif: H = 1; C = 12]

- A 0.1g
- B 0.5g
- C 1.0g
- D 2.0g

32 The following equation shows the combustion of heptane, C_7H_{16} in excess oxygen.

Persamaan berikut menunjukkan pembakaran heptana, C_7H_{16} dalam oksigen berlebihan.



In an experiment, the combustion of heptane in excess oxygen releases 1378 kJ energy.
What is the mass of heptane used?

Dalam satu eksperimen pembakaran heptana dalam oksigen berlebihan membebaskan 1378 kJ tenaga. Berapakah jisim heptana yang digunakan?

[Relative atomic mass : H = 1; C = 12]

[Jisim atom relatif: H = 1 ; C = 12]

- A 25.0 g

- B 36.0 g
C 77.0 g
D 88.0 g

- 33 An acid HX and an alkali YOH, both with the same concentration, are mixed in different volume ratios as shown in the table below. Which of the following sets of mixture will produce the highest rise in temperature?

Satu asid HX dan satu alkali YOH yang mempunyai kepekatan yang sama dicampurkan pada nisbah isipadu seperti yang ditunjukkan pada jadual di bawah. Antara larutan set berikut yang manakah akan menghasilkan kenaikan suhu yang paling besar?

	Volume of HX (cm ³) <i>Isipadu HX (cm³)</i>	Volume of YOH (cm ³) <i>Isipadu YOH (cm³)</i>
A	90	10
B	70	30
C	50	50
D	40	60

- 34 Diagram 8 below shows the apparatus set up to measure the heat energy given out in the reaction between magnesium and iron(II) sulphate solution. The experiment is repeated by using zinc and iron(II) sulphate solution.

Rajah 8 di bawah menunjukkan susunan radas untuk mengukur tenaga haba yang dibebaskan dalam tindak balas antara magnesium dan larutan besi sulfat. Eksperimen ini diulangi dengan menggunakan zink dan larutan ferum(II) sulfat.

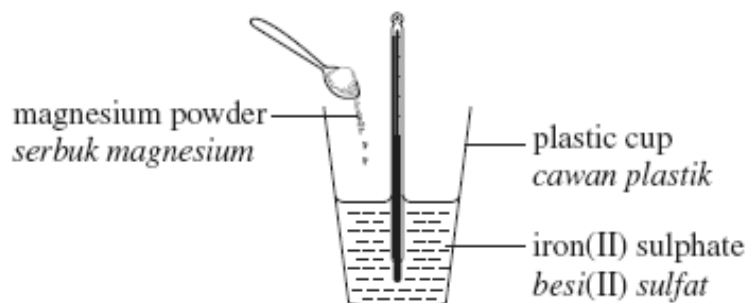


Diagram 8/ Rajah 8

Which of the following has to be constant for the reaction?

Antara yang berikut, manakah yang perlu dimalarkan dalam tindak balas ini?

- A The size of the spatula
Saiz spatula
 - B The position of the thermometer
Kedudukan termometer
 - C The volume of the iron(II) sulphate solution
Isi padu larutan ferum(II) sulfat
 - D The time taken to read the temperature of the mixture
Tempoh masa membaca suhu campuran
- 35 When 100cm^3 of 1.0 mol dm^{-3} calcium chloride solution is added to 100 cm^3 of 1.0 mol dm^{-3} sodium carbonate, there is a decrease of $t\text{ }^\circ\text{C}$ in the temperature. What is the change in temperature if 100 cm^3 of 0.5 mol dm^{-3} calcium chloride solution is added to 100 cm^3 of 0.5 mol dm^{-3} sodium carbonate?

Apabila 100cm^3 larutan 1.0 mol dm^{-3} kalsium klorida dicampurkan pada 100 cm^3 larutan 1.0 mol dm^{-3} natrium karbonat, terdapat penurunan suhu sebanyak $t\text{ }^\circ\text{C}$. Apakah

perubahan pada suhu jika 100 cm^3 larutan 0.5 mol dm^{-3} kalsium klorida dicampurkan pada 100 cm^3 larutan 0.5 mol dm^{-3} natrium karbonat?

A $2t^\circ\text{C}$ C $\frac{t}{2}^\circ\text{C}$

2

B $t^\circ\text{C}$ D $\frac{t}{4}^\circ\text{C}$

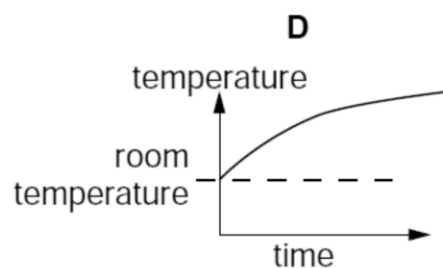
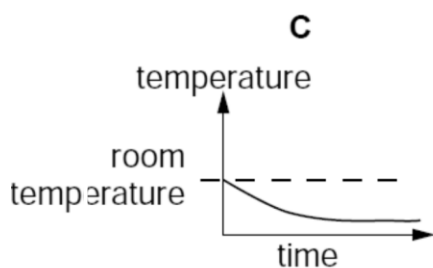
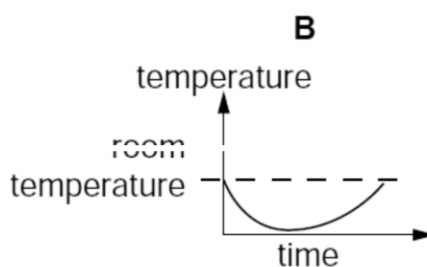
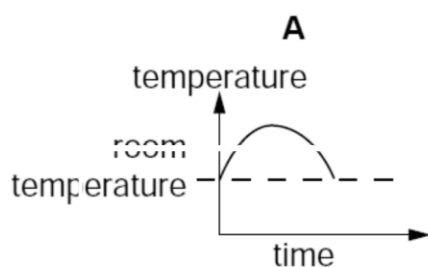
4

36 Dissolving ammonium nitrate in water is endothermic.

Which graph shows how the temperature alters as the ammonium nitrate is added to water and then the solution is left to stand?

Melarutkan ammonium nitrat dalam air adalah eksotermik.

Gambar rajah manakah menunjukkan perubahan suhu apabila ammoniumnitrat ditambahkan ke air dan seterusnya larutan itu dibiarkan?



- 37 The following equation shows the combustion of decane C_9H_{20} in excess oxygen.

Persamaan berikut menunjukkan pembakaran dekana C_9H_{20} dalam oksigen berlebihan.



In an experiment, the combustion of decane in excess oxygen releases 3192 kJ energy.

What is the mass of decane used?

[Relative atomic mass: H = 1, C = 12]

Dalam satu eksperimen, pembakaran dekana dalam oksigen berlebihan membebaskan 3192 kJ tenaga.

Berapakah jisim dekana yang digunakan?

{Jisim atom relatif: H = 1, C = 12}

A	25.0 g	C	45.0 g
B	34.0 g	D	54.0 g

- 38 Diagram 9 shows the energy level diagram of the following chemical reaction.

Rajah 9 menunjukkan gambarajah aras tenaga bagi tindak balas kimia berikut.

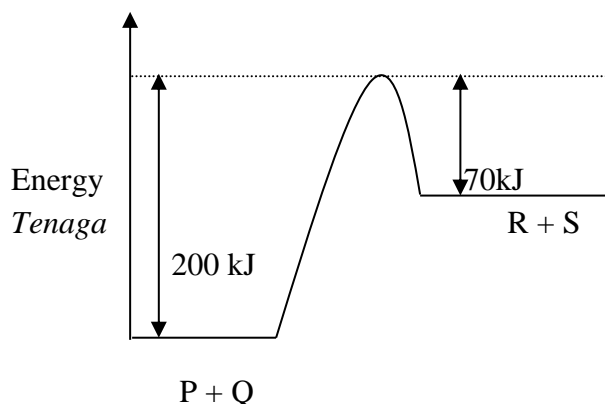


Diagram 9

Rajah 9

Which of the following statements is **true**?

Yang manakah kenyataan berikut adalah benar?

- A The heat of reaction is 70 kJ
Haba tindak balas bagi tindak balas ialah 70 kJ.
- B R and S are more stable than P and Q.
R dan S adalah lebih stabil berbanding dengan P dan Q.
- C The activation energy of reaction is 200 kJ.
Tenaga pengaktifan tindak balas ini adalah 200 kJ.

- D Heat is released when P reacts with Q to produce R and S.
Haba dibebaskan apabila P bertindak balas dengan Q untuk menghasilkan R dan S.

- 39 Apabila 1.5 g serbuk magnesium ditambahkan kepada 100 cm³ larutan kuprum(II) sulfat 1.5 mol dm⁻³, suhunya bertambah dari 25 °C ke 38 °C. Apakah haba penyesaran tindak balas?
 [Jisim atom relatif Mg = 24; Muatan haba tentu air = 4.2 J g⁻¹ °C⁻¹]

When 1.5 g of magnesium powder is added to 100 cm³ of 1.5 mol dm⁻³ copper(II) sulphate solution, the temperature increases from 25 °C to 38 °C. What is the heat of displacement for the reaction?

[Relative atomic mass of Mg = 24; Specific heat of water = 4.2 J g⁻¹ °C⁻¹]

- A 25.40 kJ mol⁻¹
- B 36.40 kJ mol⁻¹
- C 87.40 kJ mol⁻¹
- D 70.80 kJ mol⁻¹
- 40 Which of the following is true about the heat of combustion, ΔH, for methanol, propan-1-ol and butan-1-ol?

Antara yang berikut, yang manakah benar tentang haba pembakaran ΔH, bagi metanol, propan-1-ol dan butan-1-ol?

	Methanol <i>metanol</i>	Propan-1-ol <i>Propan-1-ol</i>	Butan-1-ol <i>Butan-1-ol</i>
A	-2017 kJ mol ⁻¹	-715 kJ mol ⁻¹	-2679 kJ mol ⁻¹
B	-715 kJ mol ⁻¹	-2017 kJ mol ⁻¹	-2679 kJ mol ⁻¹
C	-2679 kJ mol ⁻¹	-2017 kJ mol ⁻¹	-715 kJ mol ⁻¹
D	-715 kJ mol ⁻¹	-2679 kJ mol ⁻¹	-2017 kJ mol ⁻¹

SOALAN STRUKTUR

KERTAS 2

HEAT OF DISPLACEMENT/HABA PENYESARAN

- 1 Diagram 1 shows the apparatus set up used in experiment to determine heat of displacement of copper by zinc.

Rajah menunjukkan susunan radas yang digunakan dalam eksperimen untuk menentukan haba penyesaran kuprum oleh zink.

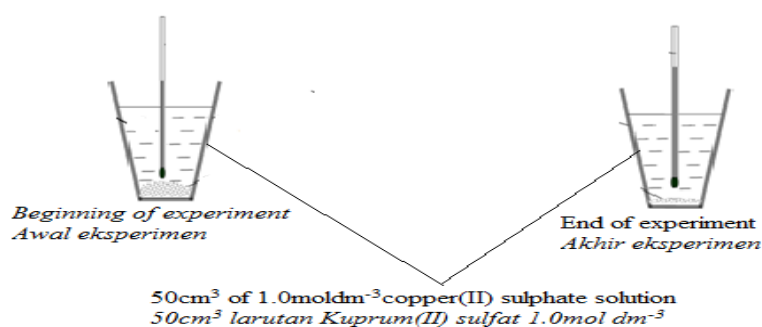


Diagram 1/ Rajah 1

Table 1 shows the results of this experiment

Jadual 1 menunjukkan keputusan eksperimen ini.

Description / Penerangan	Temperature (°C) / suhu (°C)
Initial temperature of copper(II) sulphate solution <i>Suhu awal larutan kuprum(II)sulfat</i>	29.0
Highest temperature of mixture <i>Suhu tertinggi campuran</i>	35.0

Table 1/Jadual 1

Based on the experiment,

Berdasarkan eksperimen,

- a) (a) What is the meaning of heat of displacement?
Apakah yang dimaksudkan dengan haba penyesaran?

.....

[1 mark/ markah]

- b) What is the colour change of copper(II) sulphate solution in this reaction ?
Apakah perubahan warna larutan kuprum(II) sulfat dalam tindakbalas ini ?

.....
[1 mark/ markah]

- c) Calculate :
Hitungkan :
- i) The heat released during the reaction
[Specific heat capacity of solution , $c = 4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$; Density of solution = 1 g cm^{-3}]
Haba yang dibebaskan semasa tindak balas.
[Muatan haba tentu larutan , $c = 4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$; Ketumpatan larutan = 1 g cm^{-3}]

[1 mark/markah]

- ii) The number of moles of copper (II) sulphate solution.
Bilangan mol larutan kuprum(II) sulfat.

[1 mark/markah]

- iii) The heat of displacement of copper by zinc
Haba penyesaran kuprum oleh zink

[2 marks/marks]

- d) Draw an energy level diagram for this reaction.
Lukis gambar rajah aras tenaga bagi tindak balas ini.

[3 marks/markah]

- e) i) What is the temperature change if the experiment is repeated using 50 cm³ of 0.5 mol dm⁻³ copper(II) sulphate solution?
Apakah perubahan suhu jika eksperimen diulangi dengan menggunakan 50 cm³ larutan kuprum(II) sulfat 0.5 mol dm⁻³ ?

[1 mark/markah]

- ii) (ii) Explain your answer in (e)(i).
Terangkan jawapan anda(e)(i).

[2marks/markah]

- f) The experiment is repeated by using lead powder, magnesium powder and Copper powder to replace zinc powder. Predict the heat of displacement that will be obtained and explain your answer.
Eksperimen diulang dengan menggunakan serbuk plumbum , serbuk magnesium dan serbuk kuprum untuk menggantikan serbuk zink. Ramalkan haba penyesaran yang akan diperolehi dan jelaskan jawapan anda.

- (i) Lead powder/ *serbuk plumbum*

[1 mark/markah]

- (ii) Magnesium powder/*serbuk magnesium*

[1 mark/markah]

- (iii) Copper powder/ *serbuk kuprum*

[1 mark/markah]

- g) Suggest **two** steps that can be taken to increase the accuracy of the heat of displacement obtained.
*Cadangkan **dua** langkah yang boleh diambil untuk meningkatkan ketepatan haba penyesaran yang diperolehi*
-
-

[2marks/markah]

HEAT OF PRECIPITATION/HABA PEMENDAKAN

- 2 Diagram 2 show the set-up of the apparatus of an experiment to determine the heat of precipitation. 25.0 cm^3 of 0.5 mol dm^{-3} silver nitrate solution is reacted with 25 cm^3 of 0.5 mol dm^{-3} sodium chloride solution. As a result there is a change in temperature of the mixture and a white precipitate is formed.

Rajah 2 menunjukkan susunan radas eksperimen untuk menentukan haba pemendakan. 25.0 cm^3 larutan argentum nitrat 0.5 mol dm^{-3} bertindak balas dengan 25 cm^3 larutan natrium klorida 0.5 mol dm^{-3} . Sebagai keputusan, terdapat perubahan suhu campuran dan mendakan putih terbentuk.

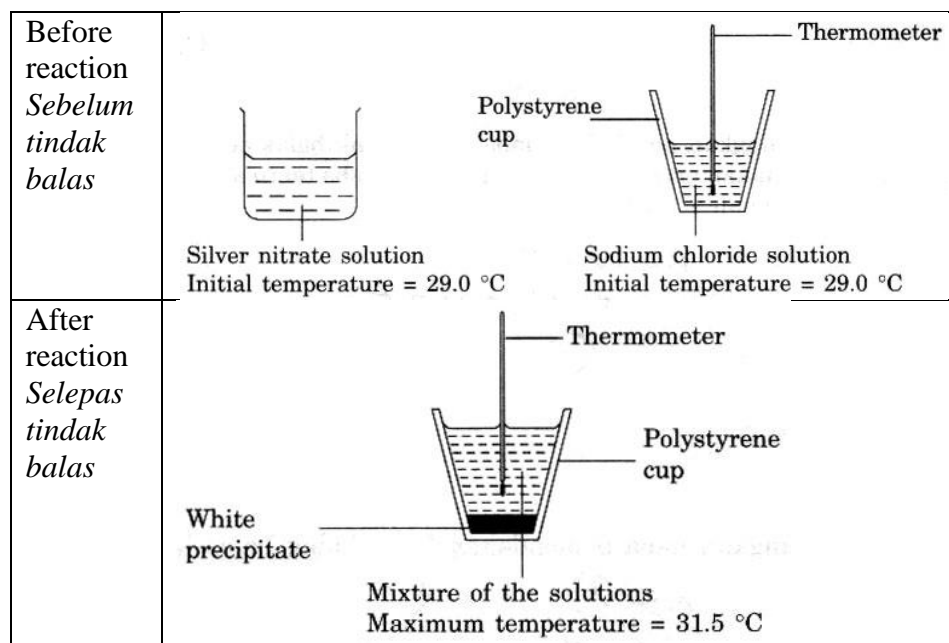


Diagram 2/ Rajah 2

- a) Why is a polystyrene cup used in the experiment?
Kenapa cawan polisterin digunakan dalam eksperimen ini?
-

[1mark/markah]

- b) Based on the change of temperature in the experiment, state the type of reaction that occurred.

Berdasarkan perubahan suhu dalam eksperimen ini, nyatakan jenis tindak balas yang berlaku.

..... [1mark/markah]

- c) How is the total energy of the product different from the total energy of the reactants?

Apakah perbezaan jumlah tenaga hasil tindak balas berbanding dengan jumlah tenaga bahan tindak?

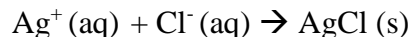
..... [1mark/markah]

- d) State **one** step that should be taken while adding the two solutions in order to get a more accurate result.

*Nyatakan **satu** langkah yang perlu diambil apabila mencampurkan kedua-dua larutan ini supaya mendapat keputusan yang lebih jitu.*

- e) The ionic equation for the precipitation reaction of silver chloride is :

Persamaan ion untuk tindak balas pemendakan argentums klorida adalah:



- i) What is the number of moles of Ag^+ ions that reacted with Cl^- ions?

Apakah bilangan mol ion Ag^+ yang bertindak balas dengan ion Cl^- ?

[1mark/markah]

- iii) Calculate the heat change of the precipitation reaction that has taken place.

Use the information that the specific heat capacity of water is $4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ and density water is 1 g cm^{-3} .

Hitung perubahan haba tindak balas pemendakan yang berlaku.

Gunakan maklumat bahawa muatan haba tentu air ialah $4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ dan ketumpatan air ialah 1 g cm^{-3} .

[2marks/markah]

- d) Calculate the heat of precipitation for this reaction.
Hitung haba pemendakan untuk tindak balas ini.

[2marks/markah]

Draw the energy level diagram for the reaction.
Lukiskan rajah aras tenaga bagi tindakbalas ini.

[2marks/markah]

- e) i) The calculated value of the heat of precipitation for this reaction is less than the actual value.
Give a reason.
*Nilai haba pemendakan yang dihitung daripada tindak balas ini adalah lebih rendah berbanding dengan nilai sebenar.
Berikan satu sebab*

[1mark/markah]

- f) Predict the heat of precipitation if sodium chloride is replaced with hydrochloric acid in the experiment.
Ramalkan haba pemendakan jika larutan natrium klorida digantikan asid hidroklorik dalam eksperimen ini.

[1mark/markah]

- f) Predict the change in temperature if the volume of both silver nitrate and sodium chloride are doubled with the same concentration. Explain your answer.
Ramalkan perubahan suhu jika isipadu argentum nitrat dan natrium klorida diganda dua tetapi dengan kepekatan yang sama . Terangkan jawapan anda.

[2marks/markah]

HEAT OF NEUTRALISATION/HABA PENEUTRALAN

- 3 A student carried out an experiment to determine the value of heat of neutralisation between hydrochloric acid and potassium hydroxide solution.
Seorang pelajar menjalankan eksperimen untuk menentukan nilai haba peneutralan antara asid hidroklorik dan kalium hidroksida

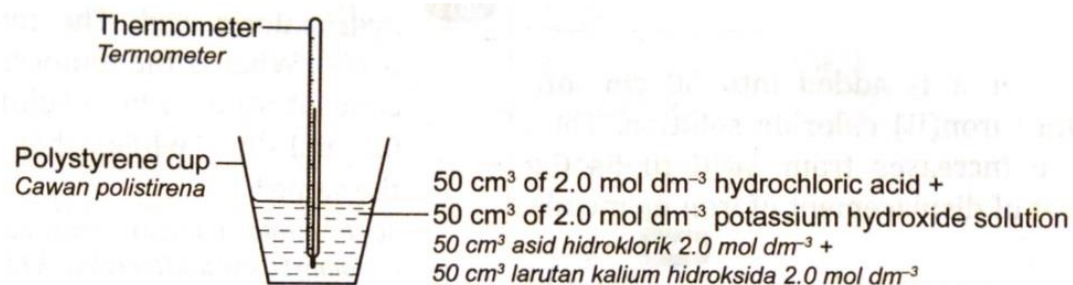


Diagram 3/ rajah 3

Initial temperature of hydrochloric acid <i>Suhu awal asid hidroklorik</i>	28.0°C
Initial temperature of potassium hydroxide solution <i>Suhu awal larutan kalium hidroksida</i>	29.0°C
Highest temperature of the mixture <i>Suhu tertinggi campuran</i>	41.5°C

Table 2/ Jadual 2

- a) What is the meaning of heat of neutralisation?
Apakah maksud haba peneutralan?

 [1mark/markah]
- b) Calculate
 Hitungkan
 the heat released during the experiment
haba yang dibebaskan semasa eksperimen
 [Specific heat capacity of solution = 4.2 J g⁻¹ °C⁻¹, density of solution = 1 g cm⁻³]
 [Muatan haba tentu larutan = 4.2 J g⁻¹ °C⁻¹, ketumpatan larutan = 1 g cm⁻³]

 [1mark/markah]
- e) the number of mol of hydrochloric acid

bilangan mol asid hidroklorik

[1mark/markah]

- i) the heat of neutralisation
haba peneutralan

[1mark/markah]

Write thermochemical equation for this reaction
Tulis persamaan termokimia bagi tindakbalas ini.

.....

[1mark/markah]

- iii) Draw an energy level diagram for this reaction.
Lukis gambar rajah aras tenaga bagi tindak balas ini.

[3 marks/markah]

- d) The experiment is repeated using 25 cm³ of 1.0 mol dm⁻³ ammonia solution to replace potassium hydroxide. The heat of neutralisation using ammonia solution is less than the heat of neutralisation using potassium hydroxide solution.

Explain the difference in the heat of neutralisation

Eksperimen ini diulang dengan menggunakan 25 cm³ larutan ammonia 1.0 mol dm⁻³ bagi menggantikan larutan kalium hidroksida. Haba peneutralan menggunakan larutan ammonia adalah kurang daripada menggunakan larutan kalium hidroksida. Terangkan perbezaan bagi haba peneutralan ini.

.....
.....
.....

[2 marks/markah]

Suggest another material that can replace the polystyrene cup in the experiment.
Cadangkan bahan lain yang boleh menggantikan cawan polistirena dalam eksperimen ini.

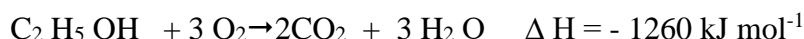
.....

[1 mark/markah]

HEAT OF COMBUSTION/ HABA PEMBAKARAN

- 4 The combustion of an alcohol in air is represented by the equation below:

Pembakaran suatu sebatian alkohol dalam udara diwakili oleh persamaan berikut:



- a) i) State the name of the alcohol in the above equation.
Nyatakan nama bagi sebatian alkohol di dalam persamaan di atas.

.....

[1mark/markah]

- ii) What is meant by ' $\Delta H = -1260 \text{ kJ mol}^{-1}$ ' in the above equation?
Apakah yang dimaksudkan dengan $\Delta H = -1260 \text{ kJ mol}^{-1}$ dalam persamaan di atas?

.....

[1mark/markah]

- b) 200 g of water is heated by the combustion of 0.23 g of the alcohol.
200 g air dipanaskan oleh pembakaran 0.23 g alkohol tersebut

- i) Calculate the heat released by the alcohol in the reaction.
[Relative Atomic Mass: H=1; C=12 and O=16]
Kirakan haba yang dibebaskan oleh alkohol itu dalam tindak balas.

[Jisim atom relatif: H=1; C=12 and O=16]

[2mark/markah]

- ii) Calculate the temperature change of water in the experiment.
[Specific heat capacity of water: $4.2 \text{ J g}^{-1}\text{C}^{-1}$]
Kirakan perubahan suhu air yang dijangkakan dalam eksperimen itu.
[Muatan haba tentu air: $4.2 \text{ J g}^{-1}\text{C}^{-1}$]

[2 marks/markah]

- c) Why is the value of heat of combustion obtained is always less than the actual value?
Mengapa nilai haba pembakaran yang didapati biasanya lebih rendah daripada nilai yang sebenar?

.....

[1mark/markah]

- d) i) Draw the energy level diagram for the combustion of the alcohol.
Lukis gambarajah aras tenaga untuk pembakaran alkohol tersebut

[3marks/markah]

- ii) Table 3 shows a list of apparatus and materials.
Jadual 3 menunjukkan senarai alat radas dan bahan.

Apparatus and Materials Alat radas dan bahan	
• Ethanol <i>Etanol</i>	• Copper can <i>Bekas kuprum</i>
• Water <i>Air</i>	• Thermometer <i>Termometer</i>
• Spirit lamp <i>Pelita</i>	• Tripod stand <i>Tungku kaki tiga</i>
• Wooden block <i>Bongkah kayu</i>	• Wind shield <i>Penghadang angin</i>

Table 3/ Jadual 3

Using the apparatus and materials listed, draw a labelled diagram to show the apparatus set-up to determine the heat of combustion of the alcohol in the laboratory.
Menggunakan radas dan bahan yang disenaraikan, lukis gambarajah berlabel yang menunjukkan susunan radas bagi menentukan haba pembakaran alcohol tersebut dalam makmal

[3 marks/markah]

- iii) State the purpose using a copper tin.
Nyatakan tujuan penggunaan tin kuprum.

[1 mark/markah]

- iv) Is it suitable to replace copper tin with aluminium can? Explain your answer.
Adakah sesuai untuk menggantikan tin kuprum dengan tin aluminium? Terangkan jawapan anda.

[1 mark/markah]

- e) i) Water is also produced during the combustion of alcohol. How can you confirm the formation of water during the experiment?
Air yang dihasilkan semasa pembakaran alkohol. Bagaimanakah anda boleh mengesahkan pembentukan air semasa eksperimen?

[1 mark/markah]

- ii) Explain why the black spots are sometimes found at the bottom of the copper tin at the end of the experiment?
Terangkan mengapa bintik hitam kadangkala ditemui dibawah tin kuprum pada akhir eksperimen?

[1 mark/markah]

- f) Table 4 below shows the heat of combustion of various alcohols.
Jadual 4 di bawah menunjukkan haba pembakaran bagi pelbagai alkohol

Number of carbon atoms per molecule of alcohol <i>Bilangan atom karbon per molekul alkohol</i>	Molecular formula <i>Formula molekul</i>	Name of substances <i>Nama sebatian</i>	Heat of combustion <i>Haba pembakaran</i> (kJ / mol ⁻¹)
1	CH ₃ OH	Methanol	-728
2	C ₂ H ₅ OH	Ethanol	-1376
3	C ₃ H ₇ OH	Propanol	-2016
4	C ₄ H ₉ OH	Butanol	

Table 4/Rajah 4

- i) Predict the heat of combustion of butanol.
Ramalkan haba pembakaran bagi butanol.

[1 mark/markah]

- ii) Heat of combustion of propanol is higher than methanol. Explain why.
Haba pembakaran propanol lebih tinggi dari metanol. Terangkan mengapa.

[1 mark/markah]

- iii) By using the data in the table, draw graph of heat of alcohol against the number of carbon atoms per molecule.
Dengan menggunakan data dalam jadual, lukiskan graf haba pembakaran alkohol melawan bilangan atom karbon per molekul.

[3 mark/*markah*]

ESSAY PAPER 2 SOALAN ESEI KERTAS 2

1. Diagram 1.1 and 1.2 show energy level diagrams.

Rajah 1.1 dan 1.2 menunjukkan gambar rajah aras tenaga.

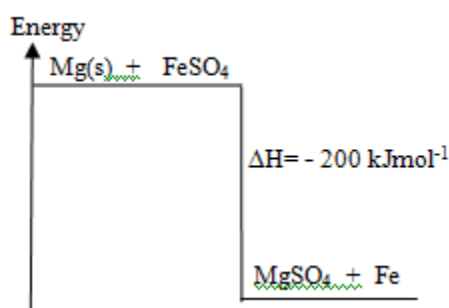


Diagram 1.1
Rajah 1.1

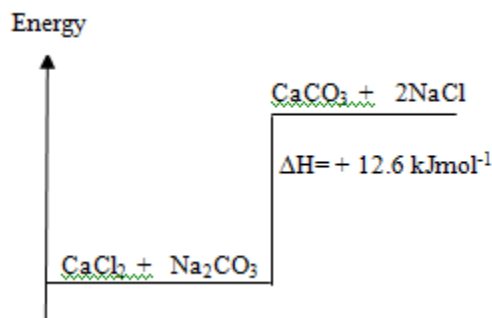


Diagram 1.2
Rajah 1.2

- a. Compare both the energy level diagrams above. Your comparison should include the following

Bandingkan kedua-dua gambar rajah aras tenaga di atas. Perbandingan anda haruslah mengandungi perkara berikut.

- Change in temperature.
Perubahan suhu.
- Type of chemical reaction
Jenis tindak balas kimia
- Total energy content of reactants and products .
Jumlah kandungan tenaga bahan dan hasil tindak balas.
- Amount of heat absorbed /released during breaking of bonds in the reactants and formation of bonds in the products
Jumlah tenaga yang diserap/ dibebaskan semasa pemecahan ikatan dalam bahan tindakbalas dan pembentukan ikatan dalam hasil tindak balas

[8 marks/ markah]

- b. Give **two** examples of exothermic reaction and **two** examples of endothermic reaction. Include chemical equations for the examples given.

*Berikan **dua** contoh tindak balas eksotermik dan **dua** contoh tindak balas endotermik. Sertakan dengan persamaan kimia untuk contoh yang diberikan.*

[8 marks/ markah]

- c. i).

Ice cubes melt when kept outside the refrigerator.
Ketulan ais melebur apabila disimpan di luar peti sejuk.

Explain the above statement.

Jelaskan kenyataan di atas.

[2 marks/2 markah]

- ii.) A student with a wet T-shirt entered an air-conditioned room. After half an hour, the student was shivering with coldness. Explain this phenomenon with reference to changes in physical state and energy change involved.

Seorang pelajar yang memakai T-shirt basah masuk ke bilik berhawa dingin. Selepas satu jam, pelajar ini menggeletar kerana sejuk. Jelaskan fenomena ini berdasarkan perubahan keadaan fizikal dan perubahan tenaga.

[2 marks / markah]

2. Table 1 shows three thermochemical equations for experiment I, II and III.

Jadual 1 menunjukkan persamaan termokimia untuk eksperimen I, II dan III.

Experiment <i>Eksperimen</i>	Thermochemical equation <i>Persamaan termokimia</i>
I	$\text{HCl (aq)} + \text{NaOH (aq)} \rightarrow \text{NaCl (aq)} + \text{H}_2\text{O(l)}, \Delta H = -57 \text{ kJ mol}^{-1}$
II	$\text{CH}_3\text{COOH(aq)} + \text{NaOH(aq)} \rightarrow \text{CH}_3\text{COONa(aq)} + \text{H}_2\text{O(l)}, \Delta H = -55 \text{ kJ mol}^{-1}$
III	$\text{H}_2\text{SO}_4\text{(aq)} + 2\text{NaOH(aq)} \rightarrow \text{Na}_2\text{SO}_4\text{(aq)} + 2\text{H}_2\text{O(l)}, \Delta H = -114 \text{ kJ mol}^{-1}$

Table 1/*Jadual 1*

Based on the thermochemical equations,

Berdasarkan persamaan termokimia ,

- (a) Explain why there is a difference in the heat of reaction for
Jelaskan kenapa terdapat perbezaan antara haba tindak balas untuk

(i) Experiment I and II

Eksperimen I dan II

(ii) Experiment I and III

Eksperimen I dan III

[12 marks/markah]

- (b) If Experiment III is repeated by replacing the sodium hydroxide solution with potassium hydroxide solution,

Sekiranya eksperimen III diulangi dengan menggantikan larutan natrium hidroksida dengan larutan kalium hidroksida,

(i) Predict the heat of reaction for the experiment

Ramalkan haba tindak balas untuk eksperimen itu

(ii) Explain your answer in (b) (i)

Jelaskan jawapan anda di b(i).

[5 marks/markah]

- (c) Based on thermochemical equation in Experiment II, calculate the heat change when 100 cm^3 2 mol dm^{-3} ethanoic acid solution react with 100 cm^3 2 mol dm^{-3} sodium hydroxide solution.

Berdasarkan persamaan kimia eksperimen II, hitung perubahan tenaga apabila 100 cm^3 asid etanoik 2 mol dm^{-3} bertindak balas dengan 100 cm^3 larutan natrium hidroksida. 2 mol dm^{-3} .

[3 marks/ markah]

- 3 (a) What is meant by exothermic and endothermic reaction?
Explain the changes in the energy content of the reactants and products for both the reactions.

Apakah yang dimaksudkan dengan tindak balas eksotermik dan endotermik?

Huraikan perubahan kandungan tenaga bahan dan hasil tindak balas bagi kedua-dua tindak balas tersebut?

[4 marks/ 4 markah]

- (b) Diagram 2 shows an energy level diagram for a chemical reaction.
Rajah 2 menunjukkan gambarajah aras tenaga bagi satu tindak balas kimia.

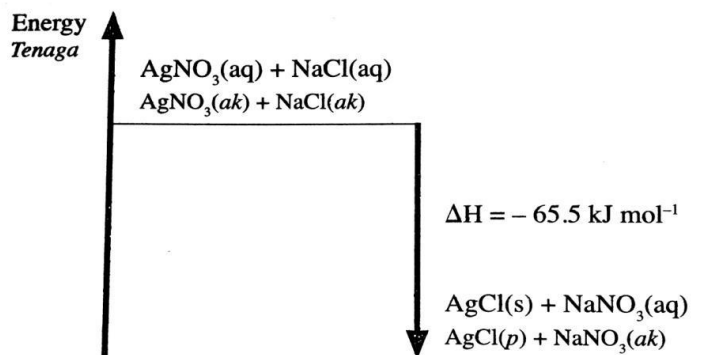


Diagram 2/ Rajah 2

State four information that can be obtained from the energy level diagram.

Nyatakan empat maklumat yang dapat diperolehi daripada gambarajah aras tenaga itu.

[4 marks / 4 markah]

- (c) Describe an experiment to determine the heat of combustion of ethanol. Your description should include the following:

Huraikan satu eksperimen untuk menentukan haba pembakaran etanol. Penerangan anda perlu mengandungi perkara-perkara berikut:

- Procedure of experiment
Prosedur eksperimen
- Results and calculation
Keputusan dan pengiraan

[12 marks/ 12 markah]

- 4 (a) Table 10 shows the heat of displacement of copper using two different metals X and Y.

Experiment <i>Eksperimen</i>	Reactants <i>Bahan tindakbalas</i>	Heat of displacement <i>Haba Penyesaran</i> (kJ mol^{-1})
I	50 cm ³ 0.2 mol dm ⁻³ copper (II) sulphate + metal X <i>50 cm³ larutan kuprum(II) sulfat 0.2mol dm⁻³ + logam X</i>	-336
II	50cm ³ 0.2 mol dm ⁻³ copper (II) sulphate + metal X <i>50 cm³ larutan kuprum(II) sulfat 0.2mol dm⁻³ + logam X</i>	-217

Table 4/Jadual 4

Based on the information in table 4,

Berdasarkan maklumat dalam Jadual 4,

- i) State on example, which could be metal X and metal Y.

Compare and explain why there is a difference in values of heat of displacement in Experiment I and II

Nyatakan satu contoh yang mungkin bagi logam X dan logam Y.

Banding dan terangkan mengapa terdapat perbezaan nilai haba penyesaran dalam Eksperimen I dan II.

[4 marks/ markah]

- ii) Write the chemical equation for Experiment I and calculate the change in temperature of the mixture.

Tulis persamaan kimia bagi Eksperimen I dan hitung perubahan suhu bagi campuran.

Specific heat capacity of solution = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$, density of solution = 1 g cm^{-3}

[Muatan haba tentu larutan = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$, ketumpatan larutan = 1 g cm^{-3}]

[6 marks/markah]

- (b) You are required to determine the heat of precipitation. The set up apparatus are shown as in the Diagram 3.

Anda diminta untuk menentukan haba pemendakan garam. Susunan radas telah ditunjukkan dalam rajah 3.

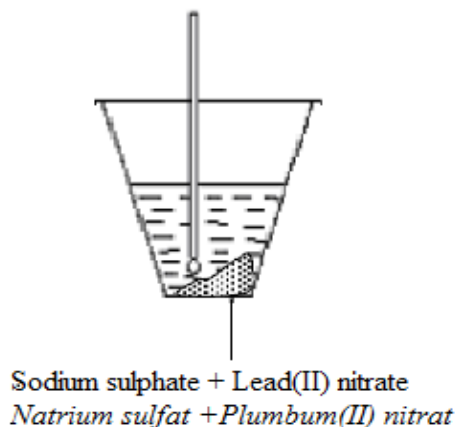


Diagram 3/ Rajah 3

- (b) Describe an experiment to determine the heat of precipitation. In your discription, include list of material and apparatus, procedures, ionic equation and the calculation needed to determine the heat of precipitation.

Huraikan satu eksperimen di makmal untuk menentukan haba pemendakan. Dalam huraian anda, masukkan senarai bahan dan radas, prosedur, persamaan ion dan pengiraan untuk menentukan haba pemendakan yang diperolehi.

[10 mark]

ESSAY QUESTION PAPER 3

SOALAN ESEI KERTAS 3

1. Brazil, the fifth largest country in the world imports no oil, since half its cars run on alcohol fuel made from sugarcane.

Diagram 1 shows an alcohol fuel station in Brazil.

Brazil, negara yang kelima besar di dunia tidak mengimport petrol, separuh daripada kereta di negara itu menggunakan bahan api alkohol yang dibuat daripada air tebu.

Rajah 1 menunjukkan sebuah stesen bahan api alkohol di Brazil.



Diagram 1/Rajah 1

Different types of alcohols produce different heat of combustions. The value of the heat of combustion depends on the number of carbon atoms per alcohol molecule. Plan a laboratory experiment to compare the heat combustion of methanol, ethanol and propan-1-ol.

Jenis alkohol yang berlainan menghasilkan haba pembakaran yang berlainan. Nilai haba pembakaran bergantung kepada bilangan atom karbon per molekul alkohol. Rancang satu eksperimen makmal untuk membandingkan haba pembakaran bagi metanol, etanol dan propan-1-ol.

Your planning should include the following aspects:

Perancangan anda haruslah mengandungi aspek-aspek berikut:

- (a) Aim of the experiment
Tujuan eksperimen

- (b) All the variables
Semua pembolehubah

- (c) Statement of the hypothesis
Pernyataan hipotesis

(d) List of substances and apparatus
Senarai bahan dan alat radas

(e) Procedure of the experiment
Prosedur eksperimen

(f) Tabulation of data
Penjadualan data

2. Diagram 2 shows two fuel meters of cars P and Q which has been filled with two different types of fuel respectively. Car P is filled with fuel X while car Q is filled with fuel Y. Both types of fuel have the same relative molecular mass. The meter shows the consumption of fuel for both cars in 300 km distance.

Rajah 2 di bawah menunjukkan 2 meter bahan api kereta P dan Q yang masing –masing telah diisi dengan dua jenis bahan api. Kereta P telah diisi dengan bahan api yang berjenama X manakala kereta Q telah diisi dengan bahan api berjenama Y .Kedua-dua bahan api X dan Y mempunyai jisim molekul relatif yang sama. Meter itu menunjukkan penggunaan bahan api bagi kedua-dua kereta itu untuk jarak 300 km.

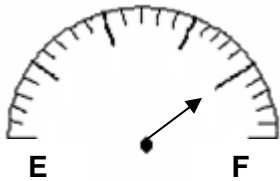
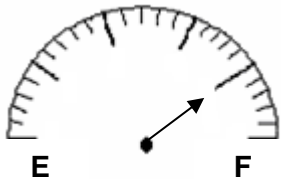
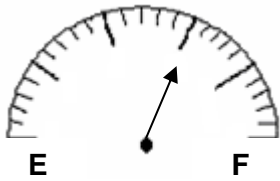
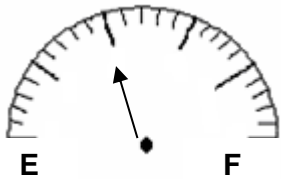
Car X <i>Kereta X</i>	Car Y <i>Kereta Y</i>
	
Fuel X at 0 km	Fuel Y at 0 km
	
Fuel X after 100 km	Fuel Y after 100 km

Diagram 2

Rajah 2

Plan an experiment to determine the heat of combustion of both fuel and decide which is more economical fuel.

Rancang satu eksperimen untuk menentukan haba pembakaran bagi bahan bakar tersebut dan tentukan yang manakah merupakan bahanapi yang lebih ekonomi.

Your planning should include the following aspects :

Perancangan anda haruslah mengandungi aspek berikut:

- a) Aim of experiment
Tujuan eksperimen
- b) All the variables
Semua pembolehubah
- c) Statement of the hypothesis
Pernyataan hipotesis
- d) List of substances and apparatus
Senarai bahan dan alat radas
- e) Procedure of the experiment
Prosedur eksperimen
- f) Tabulation of data
Penjadualan data

[17 marks]

3

Neutralisation is a reaction between an acid and an alkali to form salt and water.
Peneutralan adalah tindak balas antara asid dan alkali untuk menghasilkan garam dan air

Referring to the situation above, plan a laboratory experiment to compare the heat of neutralisation between a named strong acid with sodium hydroxide solution and heat of neutralisation between a named weak acid and sodium hydroxide solution.

Berdasarkan situasi di atas, rancangkan satu eksperimen makmal untuk membandingkan haba peneutralan di antara asid kuat yang dinamakan dengan larutan natrium hidroksida dan haba peneutralan antara asid lemah yang dinamakan dengan larutan natrium hidroksida

Your planning should include the following aspects:

Perancangan anda perlu mengikut aspek berikut:

- (a) Problem statement
Pernyataan masalah
- (b) All the variables
Semua pembolehubah
- (c) Statement of the hypothesis
Pernyataan hipotesis
- (d) List of substances and apparatus
Senarai bahan dan radas
- (e) Procedure of the experiment
Kaedah eksperimen
- (f) Tabulation of data
Penjadualan data

[17 marks/markah]

