

Name :

Class :

CONFIDENTIAL

4541/3

Chemistry

Paper 3

September

2012

1½ hours



**MAKTAB RENDAH SAINS MARA
SIJIL PELAJARAN MALAYSIA
TRIAL EXAMINATION
2012**

CHEMISTRY

Paper 3

One hour and thirty minutes

DO NOT OPEN THIS QUESTION BOOKLET UNTIL BEING TOLD TO DO SO

- Write down your name and class in the space provided
Tuliskan nama dan kelas anda pada ruang yang disediakan.
- The question booklet is bilingual.
Buku soalan ini adalah dalam dwibahasa.
- Candidates are required to answer all questions.
Calon dikehendaki menjawab semua soalan

<i>For Examiner's Use</i>		
Question	Full Mark	Mark
1	24	
2	9	
3	17	
Total	50	

This question booklet contains 16 printed pages including the front page.

For
Examiner's
Use

- 1 Two experiments are conducted to investigate the effect of size of calcium carbonate on the rate of reaction between calcium carbonate and hydrochloric acid.

Dua eksperimen telah dijalankan untuk mengkaji kesan saiz kalsium karbonat terhadap kadar tindak balas antara kalsium karbonat dan asid hidroklorik.

Diagram 1.1 shows the apparatus set-up for the experiment between 2.0 g of large calcium carbonate and 50 cm³ of 0.1 mol dm⁻³ hydrochloric acid. The burette reading was recorded at 30 second intervals.

Rajah 1.1 menunjukkan susunan radas bagi eksperimen antara 2.0 g kalsium karbonat bersaiz besar dan 50 cm³ asid hidroklorik 0.1 mol dm⁻³. Bacaan buret direkodkan pada setiap 30 saat.

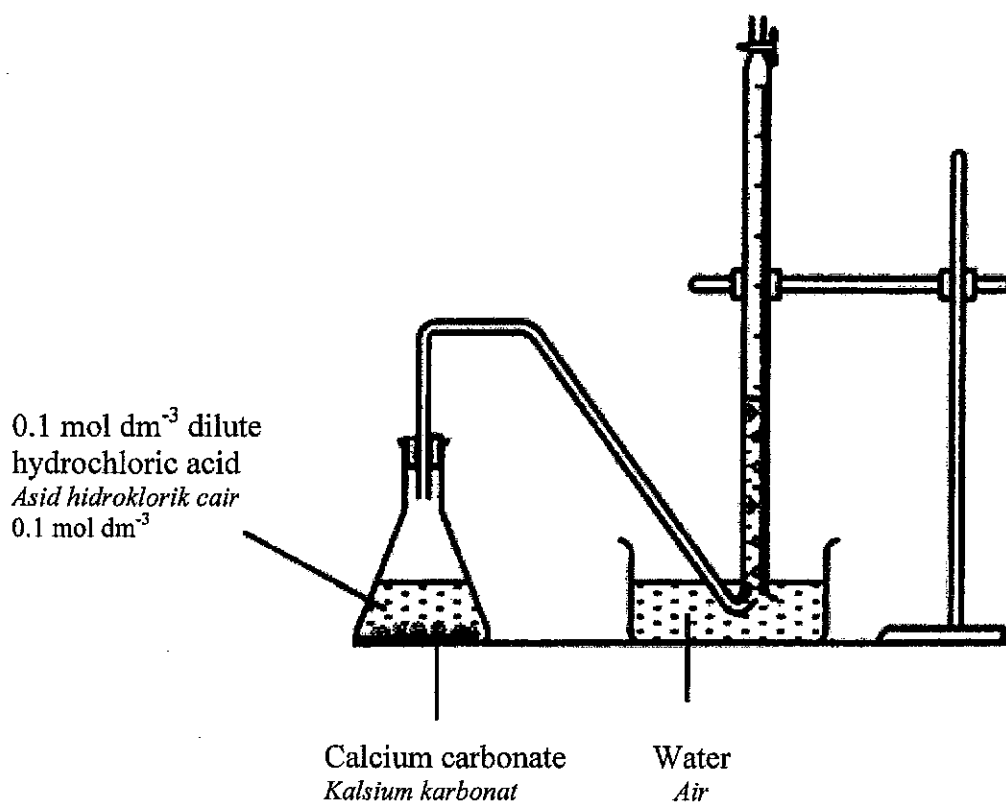


Diagram 1.1

Rajah 1.1

The experiment is repeated by using 2.0 g of small calcium carbonate to replace the large calcium carbonate.

Eksperimen ini diulangi dengan menggunakan 2.0 g kalsium karbonat bersaiz kecil menggantikan kalsium karbonat bersaiz besar.

- (a) Record the burette readings in the spaces provided in Diagram 1.2 for the experiment between the large calcium carbonate and hydrochloric acid.
 Rekod bacaan buret pada ruang yang disediakan dalam Rajah 1.2 untuk eksperimen antara kalsium karbonat bersaiz besar dengan asid hidroklorik.

[3 marks]
[3 markah]

Time = 0 s Masa	Time = 30 s Masa	Time = 60 s Masa	Time = 90 s Masa
..... cm ³ cm ³ cm ³ cm ³
Time = 120 s Masa	Time = 150 s Masa	Time = 180 s Masa	Time = 210 s Masa
..... cm ³ cm ³ cm ³ cm ³

1(a)

Diagram 1.2
Rajah 1.2

For
Examiner's
Use

CONFIDENTIAL

- (b) (i) Construct a table showing all data which include the time, burette readings and volumes of carbon dioxide gas liberated for the experiment.

Bina satu jadual yang menunjukkan semua data yang mengandungi masa, bacaan buret dan isipadu gas karbon dioksida yang terbebas untuk eksperimen ini.

1(b)(i)

[3 marks]
[3 markah]

- (ii) Based on the data in (b)(i), state how the volume of carbon dioxide gas changes throughout the experiment when large calcium carbonate react with hydrochloric acid.

Berdasarkan data di (b)(i), nyatakan perubahan isipadu gas karbon dioksida sepanjang eksperimen apabila kalsium karbonat bersaiz besar bertindak balas dengan asid hidroklorik.

.....

.....

[3 marks]
[3 markah]

1(b)(ii)

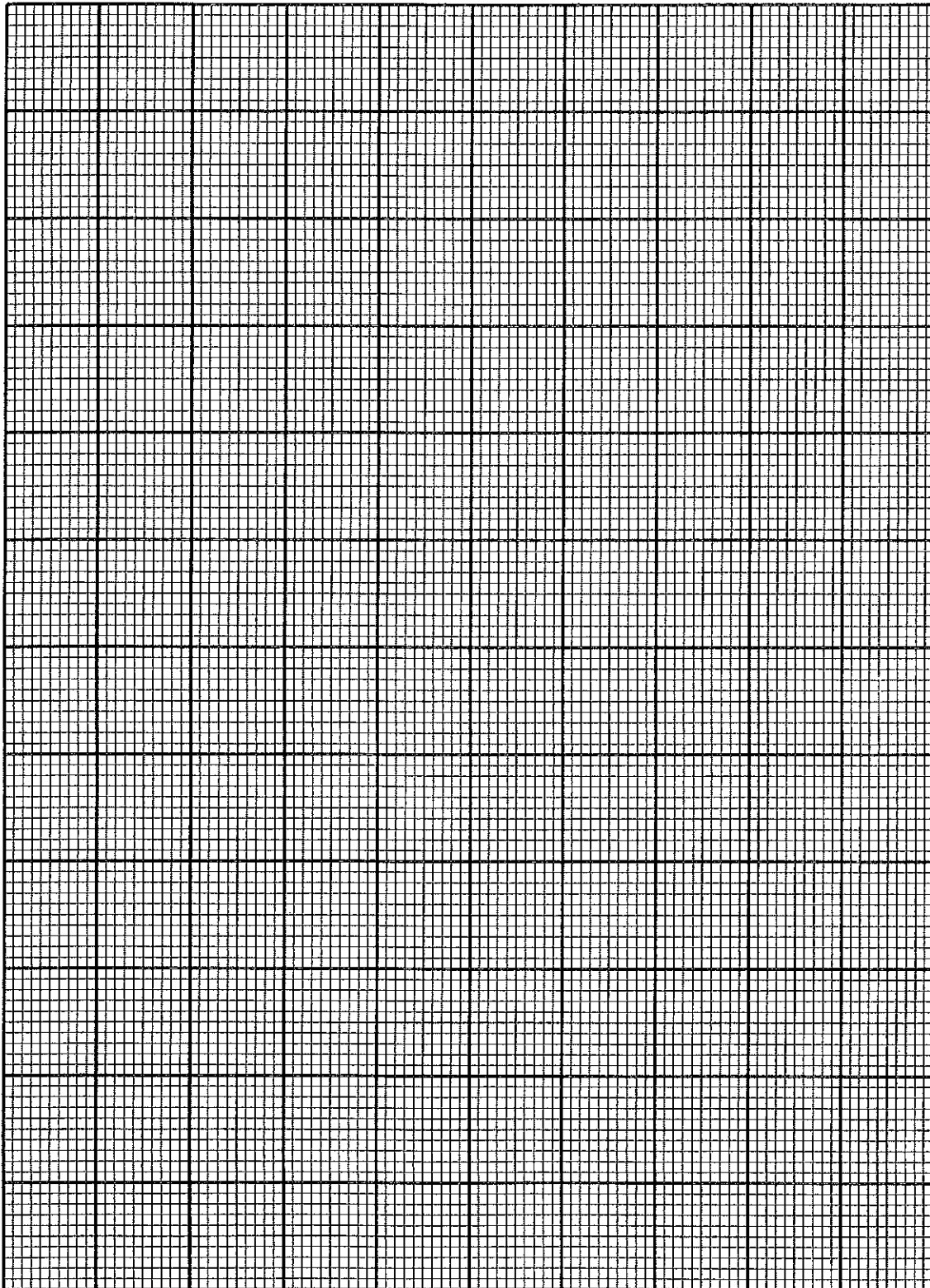
- (iii) Based on the data in (b)(i), plot a graph of volume of carbon dioxide gas against time.

Berdasarkan data di (b)(i), plotkan graf isipadu gas karbon dioksida melawan masa.

[3 marks]
[3 markah]

Graph of volume of carbon dioxide gas against time.
Graf isipadu gas karbon dioksida melawan masa.

*For
Examiner's
Use*



1(b)(iii)

For
Examiner's
Use

(c) For the experiment, state the:
Bagi eksperimen ini, nyatakan :

(i) Manipulated variable:
Pembolehubah dimanipulasikan:

.....

(ii) Responding variable :
Pembolehubah bergerak balas:

.....

(iii) Constant variable :
Pembolehubah dimalarkan:

.....

[3 marks]
[3 markah]

1(c)

(d) State the hypothesis for the experiment.
Nyatakan hipotesis untuk eksperimen ini.

.....

.....

.....

[3 marks]
[3 markah]

1(d)

(e) The experiment using small calcium carbonate takes **shorter time** to collect the maximum volume of carbon dioxide gas.
Explain why.

*Eksperimen yang menggunakan kalsium karbonat bersaiz kecil mengambil masa yang lebih pendek untuk mengumpul isipadu maksimum gas karbon dioksida.
Terangkan mengapa.*

.....

.....

.....

[3 marks]
[3 markah]

1(e)

(f) Classify the following reactions into slow and fast reaction.
Kelaskan tindak balas-tindak balas berikut kepada tindak balas lambat dan tindak balas cepat.

- * Rusting
Pengaratan
- * Double decomposition
Penguraian ganda dua
- * Combustion
Pembakaran
- * Photosynthesis
Fotosintesis

Slow reaction <i>Tindak balas lambat</i>	Fast reaction <i>Tindak balas cepat</i>

[3 marks]
[3 markah]

1(f)

For
Examiner's
Use

- 2 An experiment is carried out to determine the heat of combustion of methanol, CH_3OH . The apparatus set-up for the experiment is shown in Diagram 2.1.
 Satu eksperimen telah dijalankan untuk menentukan haba pembakaran bagi metanol, CH_3OH . Susunan radas eksperimen tersebut ditunjukkan seperti dalam Rajah 2.1.

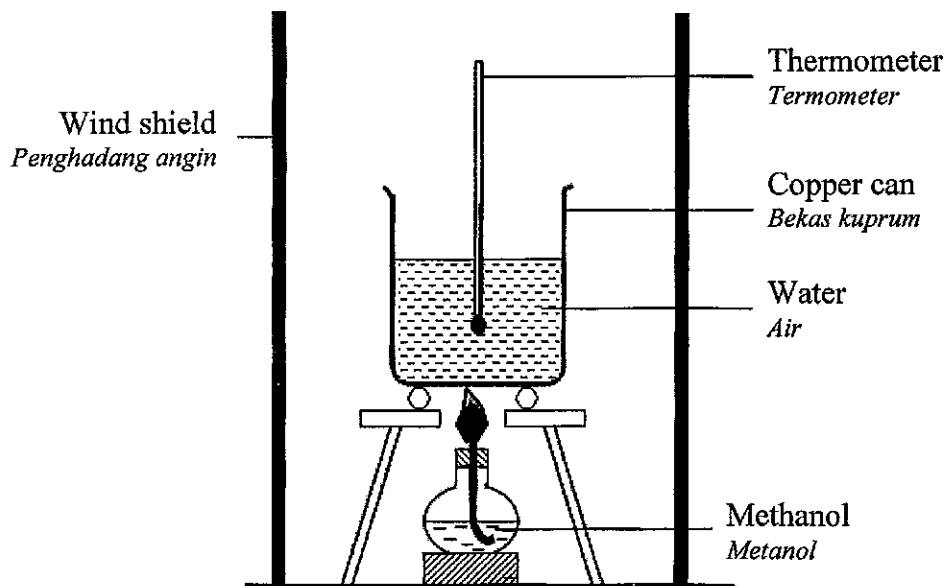


Diagram 2.1

Rajah 2.1

The following data is recorded in Table 2

Data berikut telah direkodkan dalam Jadual 2.

Volume of water <i>Isipadu air</i>	200 cm ³
Initial temperature of water <i>Suhu awal air</i>	30 °C
Highest temperature of water <i>Suhu tertinggi air</i>	60 °C
Initial mass of spirit lamp containing methanol <i>Jisim awal pelita spirit yang mengandungi metanol</i>	365.00 g
Final mass of spirit lamp containing methanol <i>Jisim akhir pelita spirit yang mengandungi metanol</i>	363.40 g

Table 2

Jadual 2

For
Examiner's
Use

- (a) State the operational definition for the heat of combustion in this experiment.

Nyatakan definisi secara operasi bagi haba pembakaran dalam eksperimen ini.

.....

[3 marks]
[3 markah]

2(a)

- (b) Calculate the heat of combustion of methanol.

Hitungkan haba pembakaran bagi metanol.

(Relative atomic mass H=1, C=12, O=16, Density of water = 1 g cm⁻³, specific heat capacity of water, c = 4.2 J g⁻¹ °C⁻¹)

(Jisim atom relatif H = 1, C = 12, O = 16, ketumpatan air 1g cm⁻³, muatan haba tentu air, c = 4.2 J g⁻¹ °C⁻¹)

[3 marks]
[3 markah]

2(b)

- (c) The experiment is repeated using ethanol, C₂H₅OH.

Predict the heat of combustion of ethanol compared to methanol.

Eksperimen ini diulangi menggunakan etanol, C₂H₅OH. Ramalkan haba pembakaran bagi etanol dibandingkan dengan metanol.

.....

[3 marks]
[3 markah]

2(c)

3

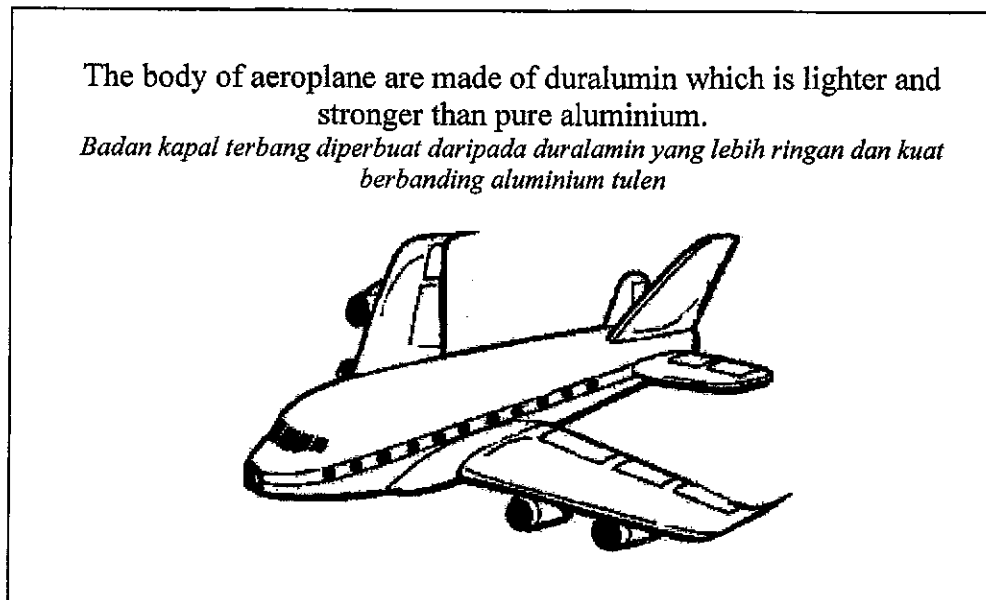


Diagram 3

Rajah 3

Referring to Diagram 3, plan a laboratory experiment to compare the hardness of a named pure metal and its alloy.

Berdasarkan Rajah 3, rancang satu eksperimen untuk membanding kekerasan logam tulen yang dinamakan dan aloinya.

Your planning should include the following aspects :

Perancangan anda hendaklah mengandungi aspek-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 for the experiment
Prosedur eksperimen
- (f) Tabulation of data
Penjadualan data

[17 marks]

[17 markah]

END OF QUESTION PAPER
KERTAS SOALAN TAMAT

SUGGESTED ANSWERS FOR MRSM PAPER 3 2012

(a) Burette reading s:

Time	0	30	60	90	120	150	180	210
Burette reading	49.60	39.60	30.10	21.60	15.10	11.10	8.10	8.10

(b) (i) Table:

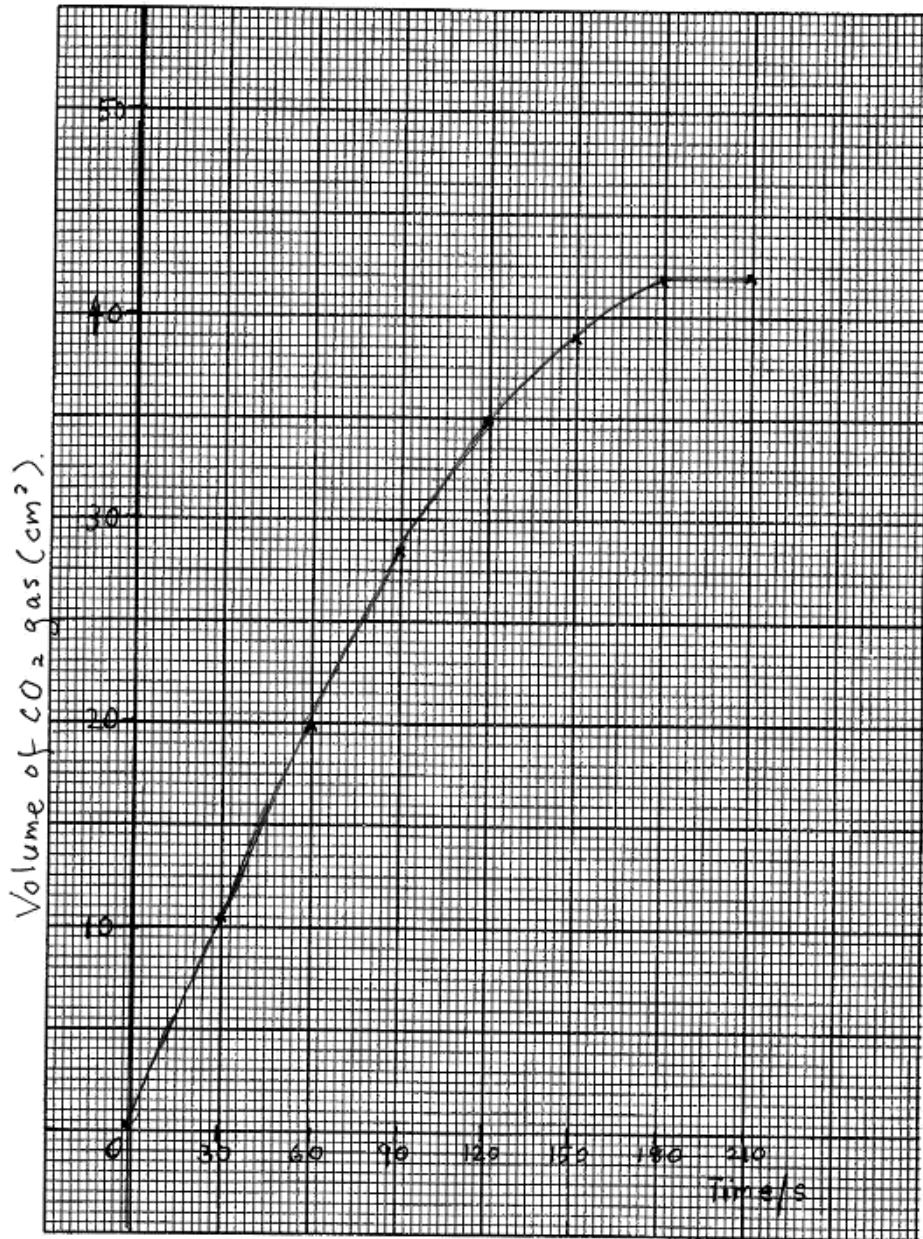
Time(s)	0	30	60	90	120	150	180	210
Burette reading(cm^3)	49.60	39.60	30.10	21.60	15.10	11.10	8.10	8.10
Volume of CO_2 (cm^3)	0.40	10.40	19.90	28.40	34.90	38.90	41.90	41.90

(ii) When the time increases, the volume of carbon dioxide gas increases until it reaches a maximum and becomes constant.

(iii) Refer to the graph.

Graph of volume of carbon dioxide gas against time.
Graf isipadu gas karbon dioksida melawan masa.

For
Examiner's
Use



1(b)(iii)

- (c) (i) manipulated variable: size of reactant// total surface area
 (ii) Responding variable: rate of reaction
 (iii) Constant variable: mass of calcium carbonate// volume and concentration of hydrochloric acid
- (d) Hypothesis: When the size of reactant is smaller, the rate of reaction is higher.
- (e) When the size of calcium carbonate is smaller, the time taken for the reaction is shorter because the total surface area is bigger. Hence frequency of collisions between CaCO_3 and H^+ ions increases. Frequency of effective collisions increases.
- (f)

Slow reaction	Fast reaction
Rusting Photosynthesis	Double decomposition Combustion

2. (a) Operational definition of heat of combustion of methanol.

- When methanol is burnt in air,
- the temperature of water increases,
- showing the heat of combustion of methanol is the heat energy released(heat change) when 1 mol of methano is burnt completely in oxygen.

(b) $H = mc\theta$
 $= 200 \times 4.2 \times 30 \text{ J}$
 $= 25200 \text{ J}$

Mass of methanol burnt = $365.00 - 363.40 \text{ g}$
 $= 1.6 \text{ g}$

Relative molecular mass of methanol (CH_3OH) = 32

No. of mol of methanol = $1.6/32 = 0.05 \text{ mol}$

Heat of combustion = $25200/0.05 = 504 \text{ kJ/mol}$

(c) 724.5 kJ/mol

Working:

[RMM of methanol is 32; RMM of ethanol is 46.

32 g of methanol \rightarrow 504 kJ

46 g of ethanol \rightarrow 724.5 kJ]

3.

(a) Problem statement:

Is brass harder than pure copper?

(b) All the variables:

Manipulated: type of metal block

Responding : Diameter of dent

Constant: mass of weight/ size of steel ball bearing/ height of weight from steel ball bearing(distant between steel ball bearing and weight)

(c) Hypothesis : The harder the metal block, the smaller is the diameter of the dent.

(d) List of substances and apparatus:

Retort stand, meter-rule, weight, steel ball bearing, copper block, brass block

(e) Procedure of experiment:

1. A steel ball bearing with diameter 1.5 cm is placed on a copper block.
2. A 0.5 kg weight is hung about 50 cm above the steel ball bearing.
3. The weight is dropped onto the ball bearing placed on the metal block.
4. The diameter of the dent formed on the copper block is then measured.
5. The above process is repeated two times using different faces on the copper block and the average diameter is then calculated.
6. The experiment is then repeated using brass block replacing copper block.

(f) Tabulation of data:

Metal block	Diameter of the dent (mm)			
	I	II	III	Average
Copper				
Brass				