

CHAPTER 3: CHEMICAL FORMULAE AND EQUATION

SECTION A: Common Mistake Made By The Candidates

1. Student not able to relate the formula in correctly.
2. student not able to use the fomula in solving numerical problem to convert the number of moles to number of particles or mass of substances and vice versa.
3. students not ables make generalization on the molar volume of the gas at a given temperature and pressure.
4. students not able to make calculation for determine of empirical formula and molecular formula.
5. Students can not construct chemical formulae.
6. Students not able to use information given in the question, solve the numerical problem involving chemical equation.
7. Students can not balance the chemical equation correctly.

$$\text{Number of moles} = \frac{m}{\text{RAM/RMM}} = \frac{V_g}{24 \text{ dm}^3} = \frac{N}{6 \times 10^{23}} = \frac{MV}{1000}$$

SECTION B: DIAGNOSTIC QUESTION

a) Objective question

1. What is formed when calcium carbonate is heated?
Apakah yang terbentuk apabila kalsium karbonat dipanaskan?

A calcium and carbon
kalsium dan karbon
B calcium and carbon dioxide
kalsium dan karbon dioksida
C calcium oxide and carbon
kalsium oksida dan karbon
D calcium oxide and carbon dioxide
kalsium dan karbon dioksida
2. Which compound are the correct formulae?
Formula sebatian yang manakah betul?

A Ammonia NH_4
Ammonia
B Carbon monoxide CO_2
karbon monoksida
C Iron(III)oxide Fe_3O_2
Ferum(III)oksida
D Zinc hydroxide $\text{Zn}(\text{OH})_2$
Zink hidroksida
3. How many atom of X are there in a mass equal to two atoms of Y?
Berapakah bilangan atom X yang sama dengan jisim 2 atom Y?
(Relative atomic mass of = X, 12 ; Y, 108)

A 9
B 12
C 15
D 18
4. A mass of zinc contain 6.02×10^{25} of particles. What is the number of moles of Zinc?
Jisim zink mengandungi 6.02×10^{25} zarah .Apakah bilangan mole bagi zink.
(Avagadro constant= $6.02 \times 10^{23} \text{ mol}^{-1}$)

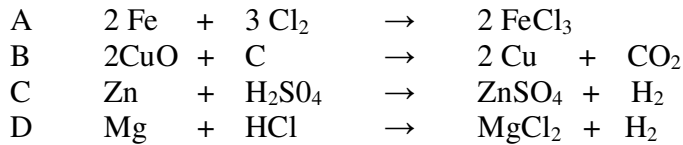
A 0.1mole
B 1.0 mole
C 10.0 mole
D 100.0 mole

5. One mole of sodium oxide, Na_2O contain;
Satu mol natrium oksida, Na_2O mengandungi;
- A 1 moles of molecule
1 mole molekul
- B 2 moles of ions
2 mol ion
- C 3 moles of ions
3 mol ion
- D 4 moles of ions
4 mol ion
6. The following shows the relative formula mass of several compound, which is **True?**
Yang berikut menunjukkan jisim formula relatif bagi beberapa sebatian. yang manakah benar?
 (Relatif atomic mass: H,1 ; C,12 ; N, 14 ; O,16 ; Mg, 24 ;K, 39)

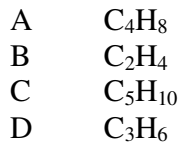
	Compound <i>Sebatian</i>	Relative formula mass <i>Jisim formula relatif</i>
A	CO_2	40
B	NH_3	16
C	K_2O	94
D	MgO	45

7. What is the mass in gram for 0.2 mole of copper carbonate?
Apakah jisim dalam unit gram bagi 0.2 mol kuprum karbonat?
 (Relative mass copper carbonate: 124)
- A 20.8g
- B 24.8g
- C 30.8g
- D 18.8g
8. Which of the following gases occupies the smallest volume at STP?
Di antara gas yang berikut yang manakah isipadu yang paling kecil pada STP?
 (Relative mass: $\text{NH}_3 = 17$; $\text{CO} = 28$; $\text{O}_2 = 32$; $\text{Cl}_2 = 71$)
 1 mole of gas occupies 22.4 dm^3 at STP
- A 4.0 g of ammonia, NH_3
- B 2.0 g of Carbon monoxide, CO
- C 3.0 g of oxygen, O_2
- D 4.0 g of chlorine, Cl_2

9. Which of the following chemical equation is not balanced?
Di antara persamaan kimia berikut yang manakah tidak seimbang?



10. A compound has the empirical formula of CH_2 . The relative molecular mass of the compound is 70. What is the molecular formula of the compound?
Suatu sebatian mempunyai formula empiric CH_2 . Jisim molekul sebatian tersebut ialah 70. Apakah formula molekul sebatian tersebut?
(Jisim atom relative : H,1 ; C,12)



11. The equation below represents of the reaction to extract metal X from X oxide. What is the mass of X metal that can be extracted from 51 g of X oxide?
Persamaan di bawah mewakili tindakbalas untuk mengestrak logam X daripada oksida X.
Berapakah jisim logam X yang boleh diestrakan daripada 51 g oksida X?
(Relatif atomic mass: O= 16; X= 27)



- A 27 g
B 26 g
C 28 g
D 25 g

b) Subjective Questions

1. a) Complete the following formula;

Lengkapkan formula yang berikut;

(i) $\text{Mole} = \frac{\quad}{\text{Molar mass}(\text{g mol}^{-1})}$

(ii) $\text{Mole} \times \text{Volume} (\text{dm}^{-3}) =$

b) Give the formula which relates the number of mole of particles and avagadro constant, N_A .

Berikan rumus yang menghubungkan bilangan mol zarah, bilangan zarah dan pemalar avagadro, N_A .

2. Calculate the following relative molecular mass.

Hitungkan jisim molekul relatif berikut;

(RAM: O=16; C=12; Na= 23; Cl= 35.5)

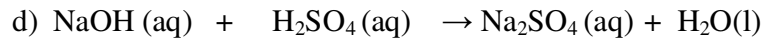
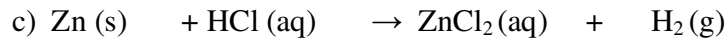
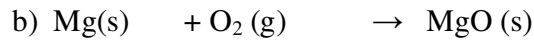
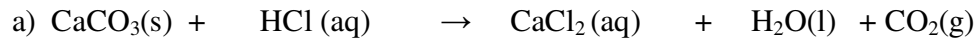
a) Carbon dioxide gas, CO_2
Gas karbon dioksida, CO_2

b) Sodium chloride, NaCl
Natrium klorida, NaCl

c) Potassium sulphate, K_2SO_4
Kalium sulfat, K_2SO_4

3. Balance the following equation;

Seimbangkan persamaan kimia berikut:



4. Calculate;

Hitungkan;

a) The number of atom in 2 mole of sodium,Na.

Bilangan atom di dalam 2 mol natrium Na.

b) How many ions are there in 2 mole of sodium chloride,NaCl?

Berapakah bilangan ion terdapat dalam 2 mol natrium klorida,NaCl?

c) The number of mole bromine molecules, Br₂, which consist of 6.01×10^{23} of bromine molecules.

Bilangan mol molekul bromine, Br₂, yang mengandungi 6.01×10^{23} molekul bromin.

d) What is the mass in gram for 0.2 mole of copper (II) Carbonate .CuCO₃.

Apakah jisim dalam gram bagi 0.2 mol kuprum(II) carbonate,CuCO₃.

e) The number of mole found in 100g of lead(II)carbonate,PbCO₃.

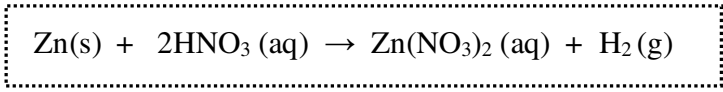
Bilangan mol terdapat di dalam 100g plumbum(II) karbonat,PbCO₃.

(RAM: Cu, 64 ; C, 12; O, 16 ; Pb, 107)

f) Calculate the number of mole of gas at s.t.p for 11.2 dm³ of nitrogen, N₂.
Hitungkan bilangan mol gas pada s.t.p bagi 11.2 dm³ gas nitrogen, N₂.

g) Calculate the volume of oxygen, O₂ gas containing 3.0 1x10²³ molecules at room temperature.
(N_A: 6.01 x10²³ Mol⁻¹ ; molar volume at s.t.p, 22.4 dm³ ; molar volume at room temperature , 24 dm³)
Hitungkan isipadu gas oksigen, O₂ yang mengandungi 3.01x10²³ molekul pada suhu bilik.

5. Zinc powder react with nitric acid produced hydrogen gas and zinc nitrate
Serbuk zink bertindak balas dengan asid nitrik menghasilkan gas hidrogen dan zink nitrat



(RAM; Zn= 65 ; N=14 ; O=16 ; Molar volume at room temperature, 24 dm³)

a) What is represent by (s), (aq) and (g)
Apakah yang diwakilkan dengan (s), (ak) dan (g)

.....

b) Describe briefly a test to identify the gas produced
Terangkan secara ringkas ujian untuk mengesahkan gas yang dibebaskan.

.....

c) Calculate the relative formula mass of zinc nitrate.
Kirakan jisim formula relatif zink nitrat

.....

- d) Calculate the mass of zinc nitrate formed when 32.5 of zinc is reacted with excess nitric acid

Hitungkan jisim zink nitrat yang terhasil, jika 32.5 g zink bertindak balas dengan asid nitrik yang berlebihan.

6. a) Define the empirical formula and molecular formula.

Takrifkan formula empiric dan formula molekul.

$\begin{aligned} (\text{Empirical formula})_n &= \text{Molecular formula} \\ n &= \text{positive the integer number} \end{aligned}$

- b) A compound has the empirical formula of CH_2O . The relative molecular mass of the compound is 180. What is the molecular formula of the compound?

Suatu sebatian mempunyai formula empiric CH_2O . Jisim molekul sebatian tersebut ialah 180. Apakah formula molekul sebatian tersebut?

(RAM: C, 12 ; H, 1 ; O, 16)

- c) 0.40g of an oxide of metal P contain 0.16g of oxygen, O_2 . What is the empirical formula of this compound?

0.40g suatu oksida logam P mengandungi 0.16 g oksigen, O_2 . Apakah formula empirik bagi sebatian ini?

(RAM : O, 16 ; P, 24)

- d) 0.42 g of the a hydrocarbon contain 0.36 g of carbon. The relative molecular mass of hydrocarbon is 84.

0.42g hidrokarbon mengandungi 0.36g karbon. Jisim moleku relatif hidrokarbon ialah 84.

(RAM: H, 1; C, 12)

- i. Find the empirical formula of the hydrocarbon.

Carikan formula empirik bagi sebatian hidrokarbon tersebut.

- ii. Find the molecular formula of the hydrocarbon.
Carikan formula molekul bagi sebatian hidrokarbon tersebut.

SECTION C: PAPER 2

a) Structure Question

1. A group of student had carried out an experiment to determine the empirical formula of magnesium oxide.
The results was obtained :
Sekumpulan pelajar telah menjalankan eksperimen untuk menentukan formula empirik magnesium oksida.

Keputusan ialah :

Mass of crucible + lid = 29.0 g
Jisim mangkuk pijar + penutup

Mass of crucible + lid + magnesium ribbon = 31.4 g
Jisim mangkuk pijar + penutup + Pita magnesium

Mass of crucible + lid + magnesium oxide = 33.0g
Jisim mangkuk pijar + penutup + magnesium oksida

- (a) Draw a labeled diagram of the set-up of the apparatus of this experiment.
Lukiskan gambar rajah berlabel yang menunjukkan susunan alat radas yang bagi eksperimen itu.

[3 marks]

(b) What is meant by empirical formula?

Apakah maksud formula empirik?

.....
[1 mark]

(c) Why was the crucible lid opened once in a while during experiment?

Kenapakah penutup mangkuk pijar dibuka sekali sekala semasa eksperimen ?

.....
[1 mark]

(d) Why was the magnesium ribbon cleaned with sand paper before it was heated?

Kenapakah pita magnesium perlu di bersihkan dengan kertas pasir terlebih dahulu sebelum dipanaskan?

.....
[1 mark]

(e) Why was the crucible covered with lid as soon the magnesium started burning?

Kenapakah mangkuk pijar perlu ditutup dengan penutup segera sebaik sahaja pita Magnesium terbakar?

.....
[1 mark]

(f) How will you ensure that all the magnesium ribbon has completely burnt?

Bagaimanakah anda memastikan semua pita magnesium terbakar dengan lengkap?

.....
[1 mark]

(g) Based on the result obtain from the experiment.

Berdasarkan keputusan yang diperolehi daripada eksperimen.

i. calculate the mass of magnesium and the mass of oxygen that has reacted.

Kirakan jisim bagi magnesium dan jisim oksigen yang telah bertindak balas.

[2 marks]

- ii. Calculate the mole ratio of magnesium atoms to oxygen atoms.
Kirakan nisbah mol bagi atom magnesium kepada atom oksigen.
(Relative atom mass ; O, 16 ; Mg, 24)

[2 marks]

- iii. Determine the empirical formula of magnesium oxide.
Tentukan formula empirik bagi magnesium oksida.

.....

[1 mark]

- iv. Write the chemical equation for the reaction in this experiment.
Tuliskan persamaan kimia yang seimbang bagi eksperimen ini.

.....

[1 mark]

b) Essay Questions

- 2 a) (i) Define the term “mole”.
Takrifkan istilah mole.

[1 mark]

- (ii) A crucible contains 0.32g of sulphur. How many moles of sulphur molecules and Sulphur atoms are found in the crucible?

Di dalam mangkuk pijar mengandungi 0.32g sulfur. Berapakah bilangan mol molekul sulfur dan atom sulfur yang terkandung dalam mangkuk pijar?

(RAM; S=32 dan $N_A, 6.01 \times 10^{23} \text{ mol}^{-1}$)

[5 marks]

- b) Name an oxide of metal and then design a laboratory experiment to determine the empirical formula of the named oxide. Your answer should consist of the following items:

Namakan logam oksida dan kemudian rancangkan satu eksperimen untuk menentukan formula empirik bagi oksida yang dinamakan. Jawapan anda mesti mengandungi perkara-perkara berikut:

- (i) Diagram showing the set-up of the apparatus
Gambarajah yang menunjukkan susunan alat radas.
- (ii) Procedure of the experiment
Kedah menjalankan eksperimen
- (iii) Calculation
Pengiraan

[14 marks]

SECTION D: PAPER 3

Structure Questions

1. A group of student performs an experiment to determine the empirical formula of lead (II) oxide. The steps and set up of the apparatus for the experiment is shown in the diagram below.

Sekumpulan pelajar menjalankan satu eksperimen bagi menentukan formula empirik plumbum(II) oksida. Langkah dan susunan radas eksperimen seperti yang ditunjukkan dalam jadual satu.

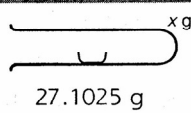
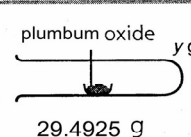
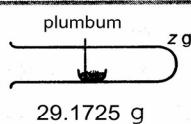
Steps	Apparatus arrangement
<p>1 Combustion tube and an empty porcelain crucible are weighed. Tabung pembakaran dan mangkuk porselin kosong ditimbang.</p>	 <p style="text-align: right;">$x\text{ g}$</p> <p style="text-align: center;">27.1025 g</p>
<p>2 Combustion tube, porcelain crucible and plumbum oxide are weighed. Tabung pembakaran, mangkuk porselin, dan plumbum oksida ditimbang.</p>	 <p style="text-align: right;">plumbum oxide $y\text{ g}$</p> <p style="text-align: center;">29.4925 g</p>
<p>3 Combustion tube, porcelain crucible and plumbum are weighed. Tabung pembakaran, mangkuk porselin, dan plumbum ditimbang.</p>	 <p style="text-align: right;">plumbum $z\text{ g}$</p> <p style="text-align: center;">29.1725 g</p>

Table 1

- a) Determine the mistake from the diagram and draw the complete of the set up of apparatus use in this experiment.

Tentukan kesilapan dalam gambar rajah diatas dan lukiskan susunan alat radas yang lengkap yang digunakan dalam eksperimen di atas.

.....

.....

[3 marks]

- b) State two observation and inference which can be made from the experiment.

Nyatakan dua pemerhatian dan inferens yang boleh dibuat dari keputusan eksperimen di atas.

Observation (pemerhatian)	Inferences(inferens)
i	
ii	

[3 marks]

- c) State the reading at two decimal point for the results of this experiment.

Catatkan bacaan pada dua tempat perpuluhan bagi keputusan eksperimen ini

	Mass(jisim),g
Combustion tube and empty porcelain crucible <i>Tabung pembakaran dan mangkuk porselin</i>	
Combustion tube,porcelain crucible and lead(II) oxide <i>Tabung pembakaran, mangkuk porselin dan plumbum (II) oksida</i>	
Combustion tube, porcelain crucible and lead <i>Tabung pembakaran ,mangkuk porselin dan plumbum</i>	

[3 marks].

d) i. What is the mass of the lead formed?
Berapakah jisim plumbum yang terhasil?

ii. What is the mass of the oxygen which had been reduced from lead(II) oxide?
Berapakah jisim oksigen yang telah dibebaskan ke udara?

[3 marks]

e) Determine the empirical formula of lead(II)oxide base on result was obtained.
Tentukan formula empiric bagi plumbum (II) oksida berdasarkan keputusan yang di perolehi.
(Relative atomic mass: O, 16 ; Pb, 207)

[3 marks]

f) Describe the steps to ensure all the air in the combustion tube has been expelled before the experiment start.
Terangkan langkah-langkah untuk memastikan semua udara disingkirkan di dalam tiub pembakaran sebelum eksperimen dijalankan.

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

[3 marks]

g) What is operational definition of empirical formula
Apakah definisi secara operasi bagi formula empiric?

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

[3 marks]