



**SECONDARY 3 CHEMISTRY
WA3 CRASH COURSE**

ACIDS, BASES, SALTS + MOLE CONCEPT & STOICHIOMETRY

**Conducted by:
Mr. Ryan Seow**



THIS CRASH COURSE IS FOR YOU IF...



You just don't understand
Acids, Bases, Salts +
Mole Concept & Stoichiometry



You want to stop getting
these questions wrong



You want to stop wasting
time revising for these
topics ineffectively

BY THE END OF THIS CRASH COURSE...



Finally understand Acids,
Bases, Salts + Mole Concept
& Stoichiometry concepts



Learn & master 5
key question types



Avoid common mistakes
to bag the A1

PIQUE YOUR BRAINS QUIZ

How well do you know Acids, Bases, Salts + Mole Concept & Stoichiometry?

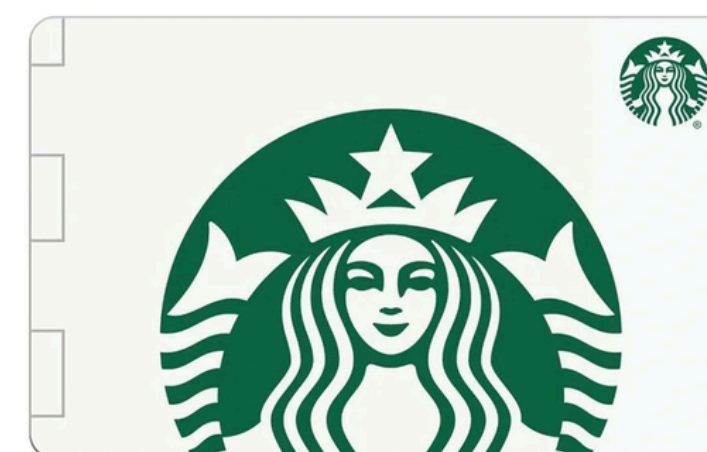
1 SCAN

Join the quiz!



2 WIN

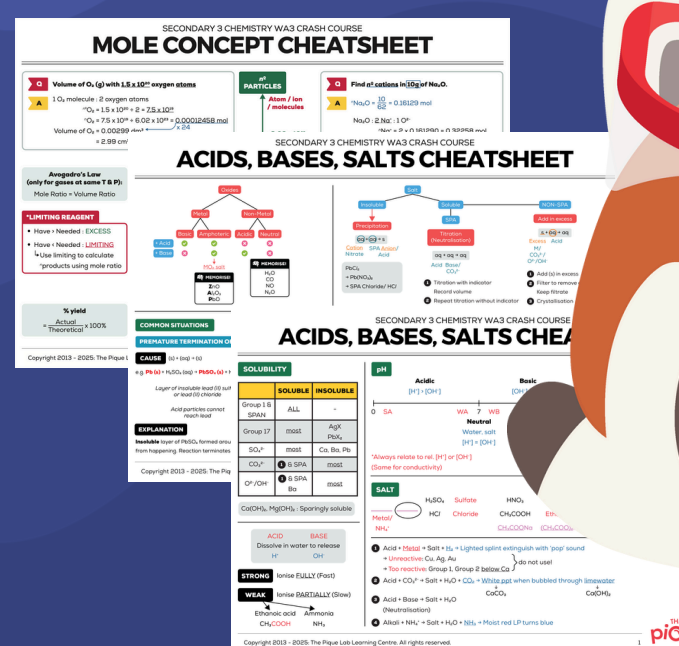
Top 3 students will win a **\$10 Starbucks gift card** from us



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The cheatsheets will be uploaded **after**
the crash course!



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whenever we release **new**
crash courses & exam tips!

IS THIS YOU?

Losing marks by giving up completely!

(i) the concentration of M_2CO_3 solution in mol/dm^3 ,

[2]

don't give up!
you can still
get some marks!

~~Give up~~

(ii) the molar mass of M_2CO_3 ,

[1]

~~110~~



Concept Recap!

STRENGTH & pH

what makes an acid "acidic"

ACID *if no water* **BASE**

Dissolve in water to release H^+ \rightleftharpoons OH^- *what makes an alkali "alkaline"*

pH

Acidic $[\text{H}^+] > [\text{OH}^-]$ **Basic** $[\text{OH}^-] > [\text{H}^+]$

STRONG Ionise FULLY (Fast)

WEAK Ionise PARTIALLY (Slow)

Ethanoic acid CH_3COOH Ammonia NH_3

$\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$
* CH_3COONa (write behind)

$\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$
ionise NOT dissociate

self-ionisation of H_2O :
 $\text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{OH}^-(\text{aq})$


**Always relate to rel. $[\text{H}^+]$ or $[\text{OH}^-]$
(Same for conductivity)*

SA $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$
 $\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$

WA **WB** **Neutral** Water, salt $[\text{H}^+] = [\text{OH}^-]$

SB $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$
 $\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$

0 7 14



COMMON MISTAKES

High concentration of H^+ = Strong acid

Weak acid:
ionises partially
in water to release
a low $[H^+]$
 \therefore higher pH

Strong acid:
ionises fully
in water to release
a high $[H^+]$
 \therefore lower pH

Same concentration

Name	pH of a 1.0 mol/dm ³ solution
Phosphoric acid	4.7
Sodium dihydrogen phosphate	4.5
Ethanoic acid	3.8
Sulfuric acid	1.0

(i) Identify a strong acid and a weak acid. Explain your reasoning.

Strong Acid: Phosphoric acid as it has the highest concentration of H^+ ions.

Weak Acid: Sulfuric acid as it has the lowest concentration of H^+ ions.

State definition compare $[H^+]$

Why?



Concept Recap!

ACID & BASE REACTIONS

- 1 Acid + Metal → Salt + H₂ → *Test for H₂:* Lighted splint extinguish with 'pop' sound

→ **Unreactive:** Cu, Ag, Au

→ **Too reactive:** Group 1, Group 2 below Ca } do not use!
- 2 Acid + CO₃²⁻ → Salt + H₂O + CO₂ → *Test for CO₂:* White ppt when bubbled through limewater

\downarrow CaCO₃
 \downarrow Ca(OH)₂
- 3 Acid + Base → Salt + H₂O
(Neutralisation)
- 4 Alkali + NH₄⁺ → Salt + H₂O + NH₃ → *Test for NH₃* **Moist** red LP turns blue

↳ acids and alkalis only release H⁺ and OH⁻ in water



COMMON MISTAKES

Missing keywords for Gas Tests / Observations / Colour Change

"Upon heating the mixture, the white solid dissolves and a pungent gas was produced."

Explain his observations with the use of a balanced chemical equation and propose a test to verify the identity of the gas.

Template :

① Test ✓

② Positive Result (?)



① Place a damp red litmus indicator at the mouth of the test tube

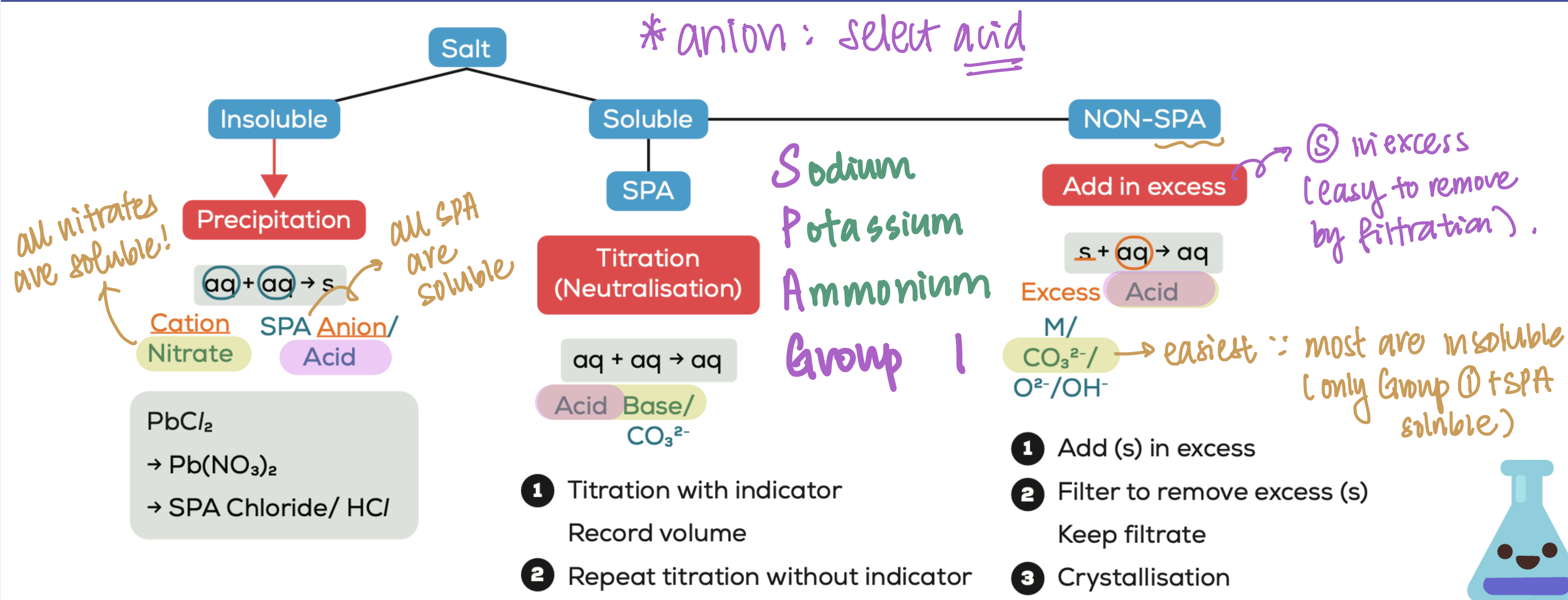
② If NH_3 is present, moist red litmus paper turns blue.



Concept Recap!

SALT PREPARATION

How to choose which method?



QUESTION TYPE 1

Choosing salt preparation method

	Soluble	Insoluble	Salt	Method	Reactants
X ⁻	most	AgX, PbX ₂			
SO ₄ ²⁻	most	BaSO ₄ , CaSO ₄ , PbSO ₄			
CO ₃ ²⁻	① + SPA	most			
OH ⁻	① + SPA Ba(OH) ₂	most			
NO ₃ ⁻	all				
			Lead sulfate (s)	precipitation	Pb(NO ₃) ₂ H ₂ SO ₄
			non-SPA Barium chloride (aq)	AIE	BaCO ₃ HCl
			Sodium nitrate		NaOH HNO ₃



Concept Recap!

INTERESTING SITUATIONS...

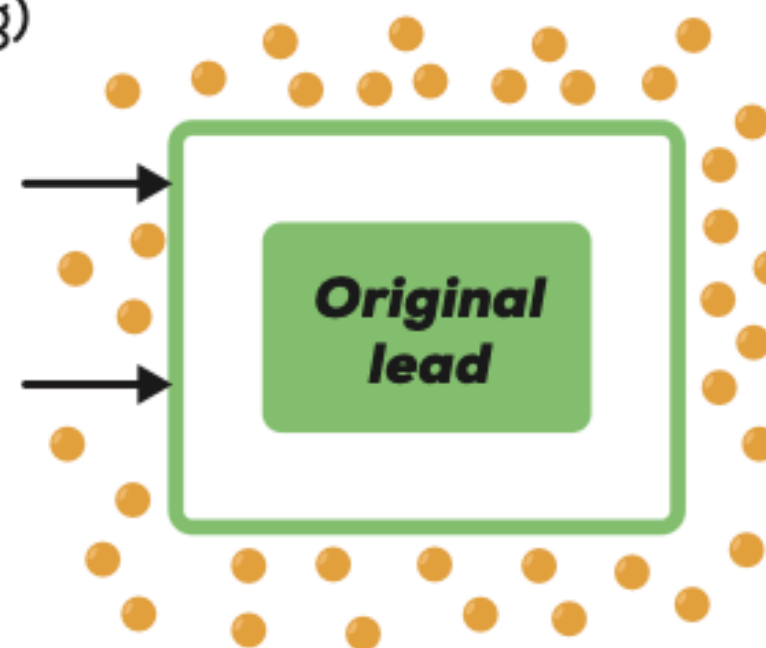
PREMATURE TERMINATION OF REACTION

CAUSE (s) + (aq) → (s)

e.g. **Pb (s)** + H₂SO₄ (aq) → **PbSO₄ (s)** + H₂ (g)

Layer of insoluble lead (II) sulfate
or lead (II) chloride

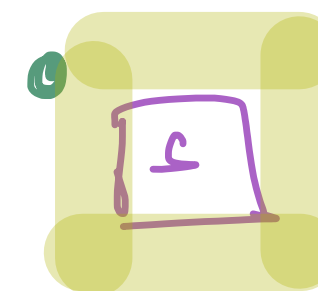
Acid particles cannot
reach lead



EXPLANATION

Insoluble layer of PbSO₄ formed around lead, preventing further reaction from happening. Reaction terminates prematurely, and the yield decreases.

* why ppt cannot
be (s) + (aq) → (s) ?

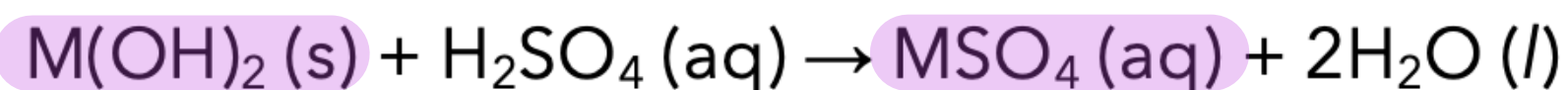


QUESTION TYPE 2

Premature Termination

2024/FMSS/WA3/A/Q3

Q2 An aqueous solution of a sulfate is made from a solid hydroxide of a metal, M, by the reaction below:



↗ Insoluble SO_4^{2-} : BaSO_4
 CaSO_4
 PbSO_4 .

Which of the following would not work?

- (1) Beryllium hydroxide
- (2) Copper(II) hydroxide
- (3) Lead(II) hydroxide
- (4) Zinc hydroxide

① no rxn (X) neutralisation is a proper rxn!
② rxn end early
 $\Rightarrow (\text{s}) + (\text{aq}) \rightarrow (\text{s})$.

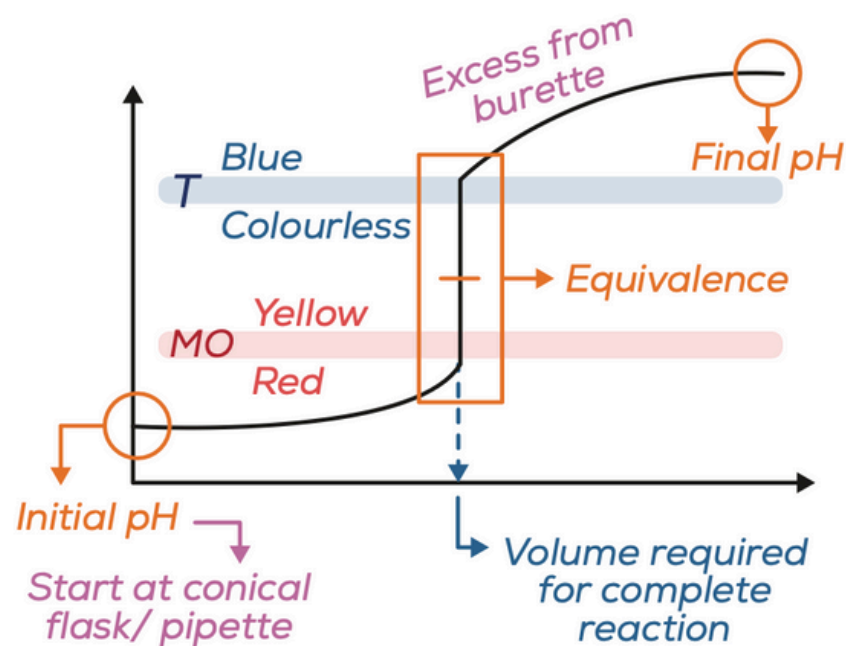
(3)



QUESTION TYPE 3

pH curves are confusing...

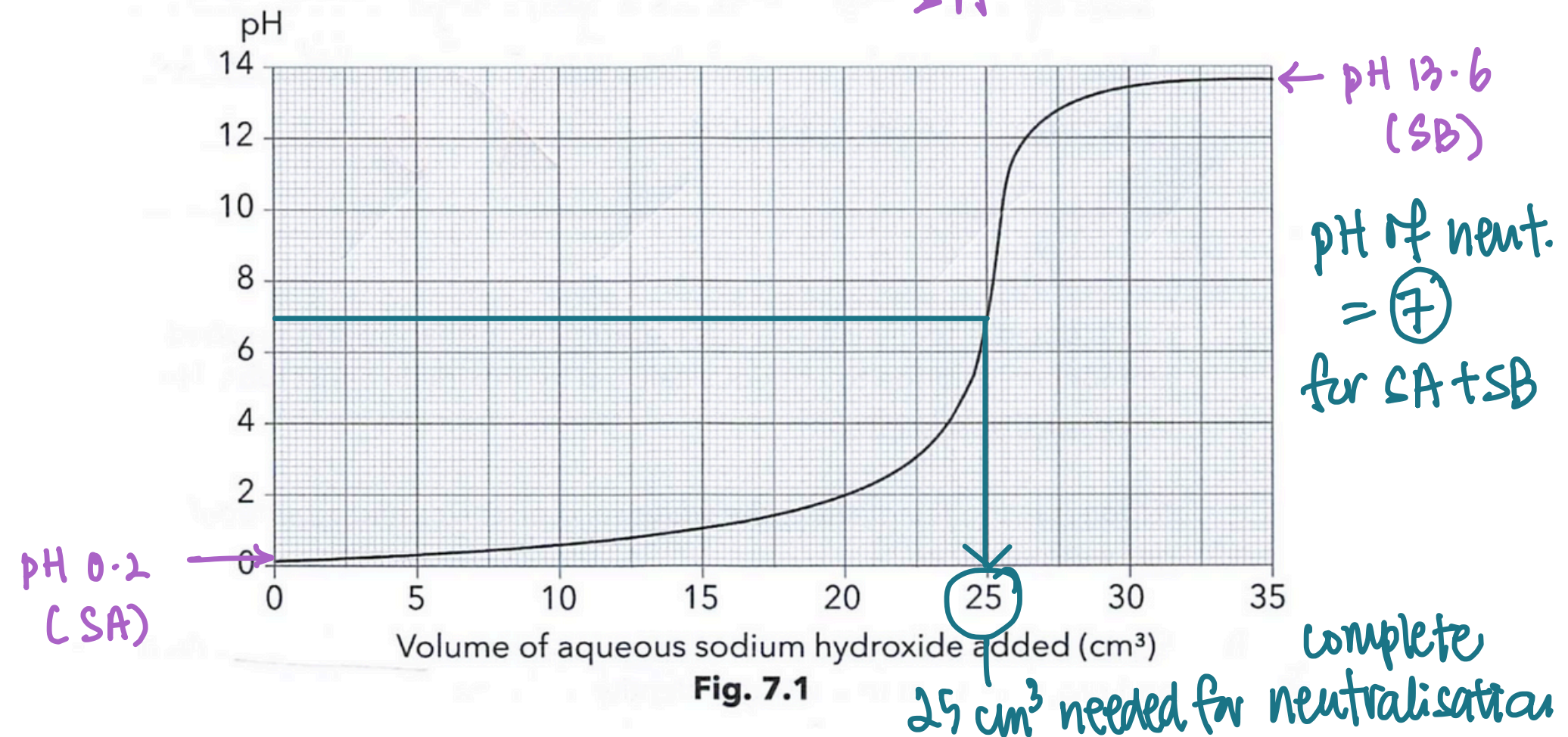
INDICATORS & TITRATION



- 1 Initial pH
- 2 Final pH
- 3 Equivalence point
 - Suitable indicator range
 - Volume required for neutralisation

EVSS/2018/S3E/CHEM/SA1/C/Q7E

Q12 In an experiment, aqueous sodium hydroxide was added from a burette to a conical flask containing 25.0 cm³ of hydrochloric acid. The pH of the solution was recorded as aqueous sodium hydroxide was added. Fig 7.1 shows a graph of the results of the experiment.

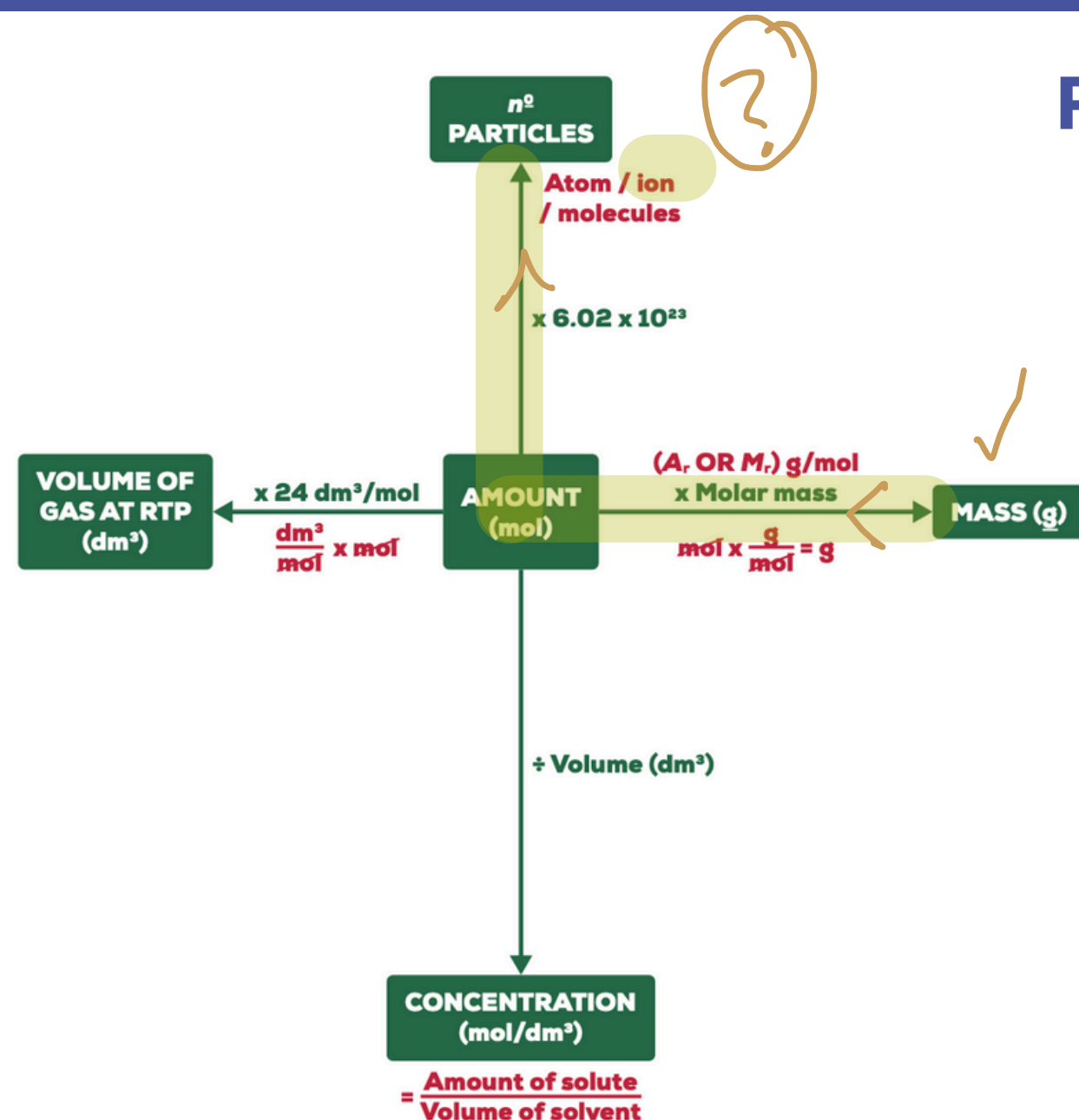


PIQUE YOUR BRAINS QUIZ!



QUESTION TYPE 4

Using Mole Flowchart



Find the number of cations in 10 g of sodium oxide



$$n_{\text{Na}_2\text{O}} = \frac{10}{62} = 0.16129 \text{ mol}$$

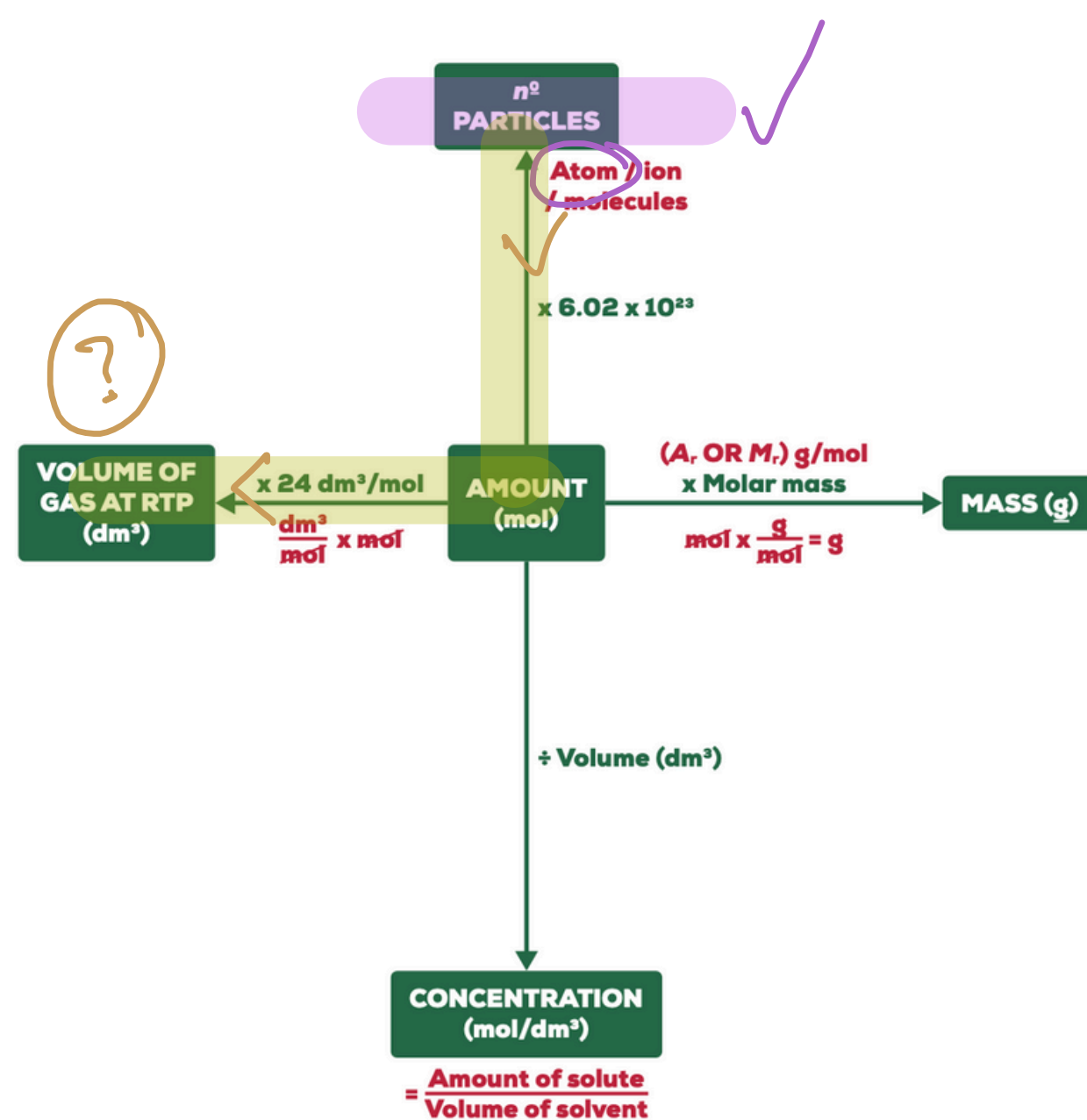
$$n_{\text{Na}^+} = 2 \times 0.16129 = 0.32258 \text{ mol.} = 6.02 \times 10^{23}$$

$$\begin{aligned} n^{\circ} \text{Na}^+ &= 0.32258 \times 6.02 \times 10^{23} \\ &= \underline{1.95 \times 10^{23}} \text{ (3sf)}. \end{aligned}$$



QUESTION TYPE 4

Using Mole Flowchart



Find the volume of oxygen gas with 1.5×10^{20} oxygen atoms

O_2 1 O_2 molecule has 2 O atoms

$$n_{O_2 \text{ molecules}} = 1.5 \times 10^{20} \div 2 = 7.5 \times 10^{19}$$

$$n_{O_2} = \frac{7.5 \times 10^{19}}{6.02 \times 10^{23}} = 0.00012458 \text{ mol}$$

$$\begin{aligned} \text{Vol } O_2 &= 0.00012458 \times 24 \\ &= 0.00299 \text{ dm}^3 \\ &= 2.99 \text{ cm}^3 \quad \times 1000 \end{aligned}$$



QUESTION TYPE 5

Combining Solutions

Total volume
 $= 150 \text{ cm}^3 = \frac{150}{1000} \text{ dm}^3$

Solution A contains 50 cm^3 of $1.0 \text{ mol/dm}^3 \text{ HCl}$
 Solution B contains 100 cm^3 of $2.0 \text{ mol/dm}^3 \text{ HCl}$

$n_{\text{HCl}} = \frac{50}{1000} \times 1.0$
 $n_{\text{HCl}} = \frac{100}{1000} \times 2.0$

Total $n_{\text{HCl}} = 0.250 \text{ mol}$

When I mix Solution A and Solution B together to make Solution C, what is the concentration of HCl in Solution C?

$$\begin{aligned}
 &\rightarrow \frac{\text{mol (mol)}}{\text{volume (dm}^3\text{)}} = 0.250 \div \frac{150}{1000} \\
 &= \underline{1.67 \text{ mol/dm}^3}
 \end{aligned}$$

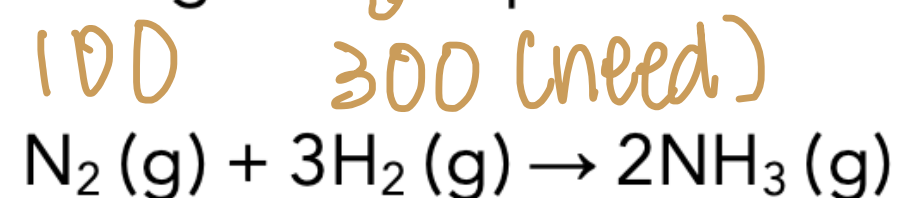


QUESTION TYPE 6

Using ICE table

2024/FMSS/WA3/A/Q9

Q3 Ammonia is formed according to the equation below:



What is the total volume of gases present at the end of the experiment when 100 cm³ of nitrogen reacts with 400 cm³ of hydrogen?

- (1) 100 cm³
- (2) 200 cm³
- (3) 300 cm³
- (4) 400 cm³

Initial	100	400	
		(have)	
Change	-100	-300	+200
End	0	100 + 200	
		300 cm ³	

* Avogadro's Law:
mole ratio = volume ratio

* always
check for
limiting reactant!

(3)



COMMON MISTAKES

Misunderstanding % yield

Total volume of oxygen: _____

98 dm³

how much
we actually
have

- (b) Assuming that the percentage yield of oxygen from the above reaction is 88%, what is the minimum mass of potassium superoxide the team should bring along in their spaceship to last them for one week?

$$\% \text{ yield} = \frac{\text{actual}}{\text{expected}} \times 100\%$$

this is
your 88%!

$$\frac{\text{actual (x)}}{98000} \times 100\% = 88\%$$

$$\begin{aligned} x &= \frac{88\% \times 98000}{100\%} \\ &= 86240 \\ &= 86,24 \end{aligned}$$

$$\begin{aligned} 88\% &\rightarrow 98 \text{ dm}^3 \\ 100\% &\rightarrow \frac{98}{88} \times 100 \end{aligned}$$



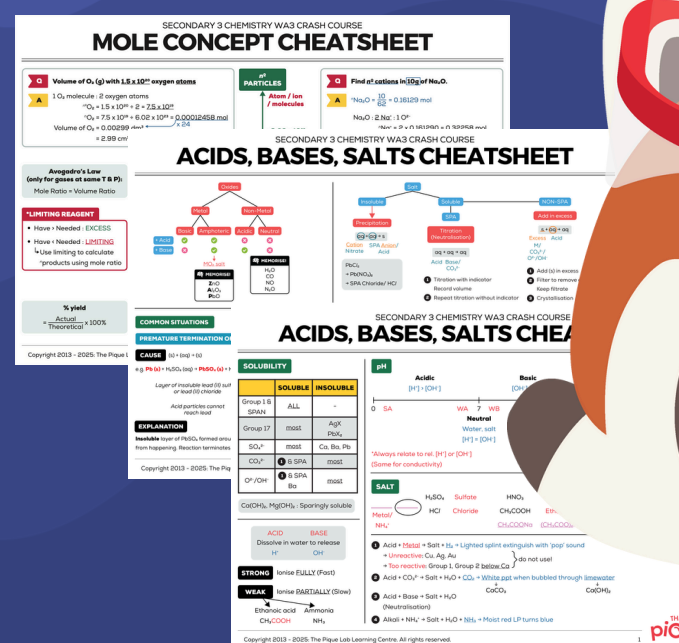
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The cheatsheets will be uploaded **after**
the crash course!



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Short Break Time!



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WHAT WE'VE COVERED



Acids, Bases, Salts + Mole
Concept & Stoichiometry
concept recap



5 Acids, Bases, Salts + Mole
Concept & Stoichiometry
question types



Common mistakes
students make

Want to apply what
you learnt INSTANTLY?

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You may be thinking...

**“HOW CAN I
PREPARE FOR
MY EOY EXAMS
IN A SMARTER
WAY?”**



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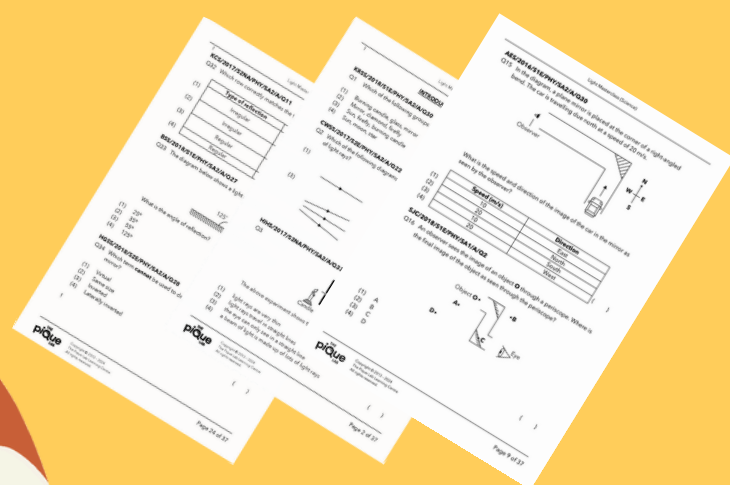
Because they have
all the solutions!



SECONDARY 3 CHEMISTRY WEEKLY GAP CLASSES

Get EOY-ready with targeted exam paper practice

Practise past year
exam papers



Build exam confidence for EOYs

- ✓ More exam question exposure
- ✓ Dissect questions faster
- ✓ Useful answering techniques to score full marks for OEQs

Strengthen your understanding of weaker topics

Discover your misconceptions

Avoid making the same mistakes again!

SECONDARY 3 CHEMISTRY WEEKLY CLASSES



Learning Arrangement

Onsite at GR.iD Campus OR
Online via Zoom



Duration

2 hours per lesson of teaching +
clarifying your questions +
practising exam style questions



Fees

\$60 registration fee
\$110 per lesson

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wine • dine • good times



Funan



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SINGAPORE'S LARGEST
OUTLET MALL

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Food & Beverage

Wingstop

Multiple malls

Deal

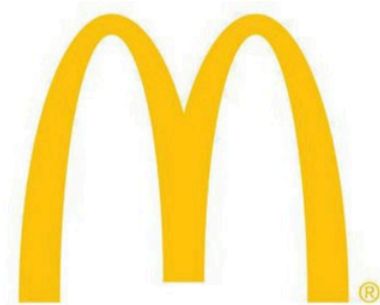


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PERI-PERI CHICKEN

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Nando's

Multiple malls



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tm
TAMPINES MALL

THE CLEMENTI
mall

westgate

The Soup
Spoon™

SECONDARY 3 CHEMISTRY WEEKLY CLASSES



Weekday Evenings

Learning Arrangement	Day	Time
Hybrid	Tuesday	4.30PM to 6.30PM
	Wednesday	7PM to 9PM (4 Seats Left!)
	Friday	7PM to 9PM
	Friday	4.30PM to 6.30PM

SECONDARY 3 CHEMISTRY WEEKLY CLASSES



Weekends

Learning Arrangement	Day	Time
Hybrid	Saturday	8.30AM to 10.30AM 4PM to 6PM (3 Seats Left!)
	Sunday	1.30PM to 3.30PM (1 Seat Left!)

PIQUE YOUR BRAINS QUIZ!



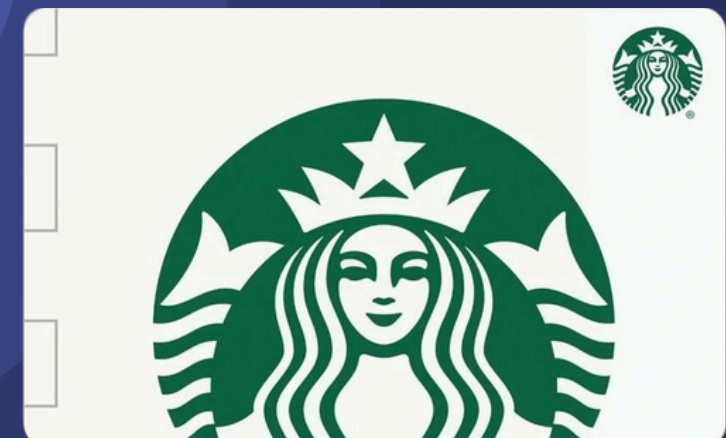


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CONGRATULATIONS!





ONE THING I WANT
YOU TO TAKE AWAY...

CHEMISTRY ISN'T JUST ABOUT
MEMORISING REACTIONS.

IT'S ABOUT SEEING HOW IDEAS
CONNECT, LIKE ATOMS
FORMING BONDS!

ONCE YOU SEE THE STRUCTURE
BEHIND IT ALL, EVERYTHING
STARTS TO MAKE SENSE.





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THANK YOU!

