

HOW TO ESCAPE

5 doors, each a puzzle in its own right – several have more than one part.

1. Work every part of a door on this pack and build its code.
2. Type the code into the terminal to open the door.
3. Write down the key digit it gives you.
4. Combine all 5 key digits into the master override and escape.

TEAM NAME

TERMINAL

🔒 DOOR 1 PERIODIC TABLE

GROUPS 1 & 7

Part 1. Halogens (IDs only) were added to solutions of the others' salts. ✓ = displacement, ✗ = none, · = not tested.

added ↓	2	4	7
2	—	✗	✗
4	✓	—	✗
7	✓	✓	—

Put the IDs in order most → least reactive.

Part 2. (increases = 1 · decreases = 2) going **down** Group 1, reactivity and going **down** Group 7, reactivity .

Door code = the reactivity IDs, then the trend digits.

DOOR
CODE

KEY
DIGIT

Three gases were tested. Identify each and read its code digit.

hydrogen = 3 · oxygen = 7 · carbon dioxide = 1 · chlorine = 9 · ammonia = 5

GAS 1

A lit splint gives a squeaky pop.

code

GAS 2

It turns limewater milky.

code

GAS 3

It relights a glowing splint.

code

Door code = the gas digits, in order.

DOOR
CODE

KEY
DIGIT

For each salt, choose the correct **preparation method** and write its number. Use the solubility rules.

Methods: 1 = excess solid (metal / insoluble base / carbonate) + acid, then filter · 2 = titration (soluble alkali + acid) · 3 = precipitation (mix two solutions, filter)

Sodium chloride

Silver chloride

Zinc sulfate

Reactive-metal soluble salt → titration; other soluble salt → excess; insoluble → precipitation. Door code = the method numbers, in order.

DOOR
CODE

KEY
DIGIT

Work out each answer and write it in the box.

$A_r: \text{Ca} = 40 \cdot \text{C} = 12 \cdot \text{O} = 16$

1 Work out the M_r of calcium carbonate, CaCO_3 .

2 Work out the % by mass of calcium in CaCO_3 .

Door code = the answers in order (numbers only, no units).

DOOR
CODE

KEY
DIGIT

Part 1. Classify each molecule as an alkane or an alkene from its formula. alkane = 1 · alkene = 2

C_2H_6

C_3H_6

CH_4

Part 2. How many carbon atoms are in a molecule of C_3H_6 ?

Alkanes fit C_nH_{2n+2} ; alkenes fit C_nH_{2n} . Door code = the classifications, then the Part 2 answer.

DOOR
CODE

KEY
DIGIT

Each clue gives only a **type** of element. Exactly one element of that type is hidden in the grid – **find it**, then write the **first letter** of each element. Enter them in order 1-4 for the code.

D	J	H	M	M	A	G	N	E	S	I	U	M
D	X	O	J	J	Z	X	H	P	H	B	U	F
N	M	I	T	M	X	X	A	C	N	I	Z	K
J	V	W	M	Y	P	Y	A	T	U	G	X	V
U	C	A	L	Q	M	T	O	Y	W	Y	J	P
D	Z	S	X	U	H	M	I	B	D	R	U	D
C	W	E	H	M	U	I	D	O	S	X	P	U
A	O	L	Z	I	J	N	J	N	P	O	Q	G
V	G	J	W	C	H	B	A	G	W	E	D	D
J	E	N	I	R	O	L	H	C	B	Z	V	T
I	D	V	I	C	V	L	M	L	B	P	W	O
L	P	P	G	Q	V	P	F	N	Z	V	E	W
R	L	L	Z	M	U	A	S	Z	V	S	C	X

1. A Group 1 metal
2. A Group 2 metal
3. A transition metal
4. A Group 7 element (a halogen)

CODE 1 2 3 4

The clue only tells you the group – the grid tells you which element it is.

MASTER OVERRIDE

Every door green? Write your key digits in order, then enter the master code to escape.

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DOOR 1 DOOR 2 DOOR 3 DOOR 4 DOOR 5

Enter codes at: _____

HOW TO ESCAPE

6 doors, each a puzzle in its own right – several have more than one part.

1. Work every part of a door on this pack and build its code.
2. Type the code into the terminal to open the door.
3. Write down the key digit it gives you.
4. Combine all 6 key digits into the master override and escape.

TEAM NAME

TERMINAL

🔒 DOOR 1 PERIODIC TABLE

GROUPS 1 & 7

Part 1. Halogens (IDs only) were added to solutions of the others' salts. ✓ = displacement, ✗ = none, · = not tested.

added ↓	2	4	7
2	—	✗	✗
4	✓	—	✗
7	✓	✓	—

Put the IDs in order most → least reactive.

Part 2. (increases = 1 · decreases = 2) going **down** Group 1, reactivity and going **down** Group 7, reactivity .

Part 3. When potassium reacts with water, a gas is given off. Give the M_r of that gas.

Door code = the reactivity IDs, then the trend digits, then the M_r

DOOR
CODE

KEY
DIGIT

Four unknown gases were tested. Identify each and read its code digit.

hydrogen = 3 · oxygen = 7 · carbon dioxide = 1 · chlorine = 9 · ammonia = 5

GAS 1

A lit splint gives a squeaky pop.

code

GAS 2

It turns limewater milky.

code

GAS 3

It relights a glowing splint.

code

GAS 4

It bleaches damp litmus paper.

code

Precipitates. Each solution gives a coloured precipitate with sodium hydroxide. Identify the metal ion from its colour, then write its **charge** as the digit.

A blue precipitate

A red-brown precipitate

Door code = the gas digits, then the precipitate charges, in order.

DOOR
CODE

KEY
DIGIT

For each salt, choose the correct **preparation method** and write its number. Use the solubility rules.

Methods: 1 = excess solid (metal / insoluble base / carbonate) + acid, then filter · 2 = titration (soluble alkali + acid) · 3 = precipitation (mix two solutions, filter)

Sodium chloride

Barium sulfate

Zinc sulfate

Silver chloride

Copper(II) nitrate

Reactive-metal soluble salt → titration; other soluble salt → excess; insoluble → precipitation. Door code = the method numbers, in order.

DOOR
CODE

KEY
DIGIT

Work out each answer and write it in the box.

$A_r: \text{Mg} = 24 \cdot \text{O} = 16$

1 Work out the M_r of magnesium oxide, MgO.

2 Work out the % by mass of magnesium in MgO.

3 $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$. What mass of MgO forms from 48 g of magnesium?

Door code = the answers in order (numbers only, no units).

DOOR
CODE

KEY
DIGIT

Part 1. Classify each molecule as an alkane or an alkene from its formula. alkane = 1 · alkene = 2

C_2H_6

C_3H_6

C_4H_{10}

C_2H_4

Part 2. How many carbon atoms are in a molecule of C_3H_6 ?

Isomers. How many structural isomers does C_4H_{10} have?

Alkanes fit C_nH_{2n+2} ; alkenes fit C_nH_{2n} . Door code = the classifications, then the Part 2 answer, the isomer count.

DOOR
CODE

KEY
DIGIT

🔒 DOOR 6 TITRATION

READ THE BURETTE

Work out each **titre** (final – initial), pick the **concordant** results (within 0.10 cm³), then find their **mean titre**.

Run	Initial / cm ³	Final / cm ³	Titre / cm ³
Rough	0.00	25.60	
1	0.00	24.50	
2	0.50	25.05	
3	0.00	24.45	

Mean titre (cm³), then × 100

Ignore the rough run and any non-concordant titre. Door code = the mean titre × 100.

DOOR
CODE

KEY
DIGIT

Each clue gives only a **type** of element. Exactly one element of that type is hidden in the grid – **find it**, then write the **chemical symbol** of each element (find iron → write **Fe**). Enter them in order 1–4 for the code.

D	N	V	G	G	E	J	S	O	D	I	U	M
R	U	K	K	U	J	A	V	U	E	E	U	K
U	M	A	G	N	E	S	I	U	M	N	B	E
L	Q	P	Y	L	F	L	E	U	I	I	H	N
M	C	Z	V	L	J	T	N	B	S	R	R	J
T	A	J	Z	O	Q	X	O	V	G	O	C	G
Y	N	P	S	I	X	V	R	I	F	L	Q	A
E	O	D	D	Z	J	M	I	E	D	H	A	G
X	A	H	B	D	B	M	R	E	Q	C	D	K
H	A	O	Q	W	L	O	U	C	E	A	N	R
D	E	F	S	K	Y	L	P	S	G	N	Q	L
Q	T	A	C	Q	T	G	C	L	Z	O	B	A
S	V	M	S	S	V	J	O	R	O	M	E	S

1. A Group 1 metal
2. A Group 2 metal
3. A transition metal
4. A Group 7 element (a halogen)

CODE

The clue only tells you the group – the grid tells you which element it is.

MASTER OVERRIDE

Every door green? Write your key digits in order, then enter the master code to escape.

DOOR 1

DOOR 2

DOOR 3

DOOR 4

DOOR 5

DOOR 6

Enter codes at: _____

HOW TO ESCAPE

7 doors, each a puzzle in its own right – several have more than one part.

1. Work every part of a door on this pack and build its code.
2. Type the code into the terminal to open the door.
3. Write down the key digit it gives you.
4. Combine all 7 key digits into the master override and escape.

TEAM NAME

TERMINAL

🔒 DOOR 1 PERIODIC TABLE

GROUPS 1 & 7

Part 1. Halogens (IDs only) were added to solutions of the others' salts. ✓ = displacement, ✗ = none, · = not tested.

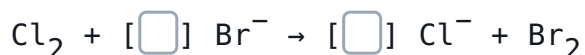
added ↓	1	3	6	9
1	—	✗	✗	✗
3	✓	—	·	✗
6	✓	·	—	✗
9	✓	✓	✓	—

Clue: halogen **6** is more reactive than halogen **3**.

Put the IDs in order most → least reactive.

Part 2. When potassium reacts with water, a gas is given off. Give the M_r of that gas.

Part 3. Balance the ionic equation, then say whether the bromide/iodide ions are oxidised or reduced (oxidised = 1 · reduced = 2).



The halide ions are

Door code = the reactivity IDs, then the M_r , then the coefficients, then the redox digit.

DOOR
CODE

KEY
DIGIT

Five unknown gases were tested. Identify each and read its code digit.

hydrogen = 3 · oxygen = 7 · carbon dioxide = 1 · chlorine = 9 · ammonia = 5

GAS 1

A lit splint gives a squeaky pop.

code

GAS 2

It bleaches damp litmus paper.

code

GAS 3

It turns limewater milky.

code

GAS 4

It relights a glowing splint.

code

GAS 5

Damp red litmus paper turns blue.

code

Precipitates. Each solution gives a coloured precipitate with sodium hydroxide. Identify the metal ion from its colour, then write its **charge** as the digit.

A blue precipitate

A green precipitate

A red-brown precipitate

Door code = the gas digits, then the precipitate charges, in order.

DOOR
CODE

KEY
DIGIT

For each salt, choose the correct **preparation method** and write its number. Use the solubility rules.

Methods: 1 = excess solid (metal / insoluble base / carbonate) + acid, then filter · 2 = titration (soluble alkali + acid) · 3 = precipitation (mix two solutions, filter)

Sodium chloride

Barium sulfate

Zinc sulfate

Silver chloride

Copper(II) nitrate

Potassium nitrate

Neutralisation. Complete the ionic equation for making water: $\text{H}^+ + \text{OH}^- \rightarrow ?$ then write the **number of hydrogen atoms** in the product.

Strength. Is sodium hydroxide a strong or weak alkali? (strong = 1 · weak = 2)

Reactive-metal soluble salt → titration; other soluble salt → excess; insoluble → precipitation. Door code = the method numbers, the H count, the strength digit, in order.

DOOR
CODE

KEY
DIGIT

Work out each answer and write it in the box.

$A_r: \text{Fe} = 56 \cdot \text{O} = 16$

1 Work out the M_r of iron(III) oxide, Fe_2O_3 .

2 Work out the % by mass of iron in Fe_2O_3 .

3 $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$. What mass of Fe_2O_3 forms from 112 g of iron?

4 How many moles are in 320 g of Fe_2O_3 ?

Door code = the answers in order (numbers only, no units).

DOOR
CODE

KEY
DIGIT

Part 1. Classify each molecule as an alkane or an alkene from its formula. alkane = 1 · alkene = 2

C_3H_8

C_4H_8

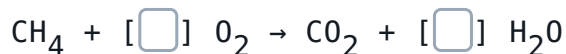
C_2H_6

C_5H_{10}

Part 2. Alkenes are C_nH_{2n} . How many hydrogen atoms are in the alkene with 4 carbons?

Isomers. How many structural isomers does C_4H_{10} have?

Combustion. Balance this complete-combustion equation and read the coefficients.



Alkanes fit C_nH_{2n+2} ; alkenes fit C_nH_{2n} . Door code = the classifications, then the Part 2 answer, the isomer count, the coefficients.

DOOR
CODE

KEY
DIGIT

Work out each **titre** (final – initial), pick the **concordant** results (within 0.10 cm³), then find their **mean titre**.

Run	Initial / cm ³	Final / cm ³	Titre / cm ³
Rough	0.00	27.00	
1	0.00	26.10	
2	0.20	26.35	
3	0.00	26.05	

Mean titre (cm³), then $\times 100$

Method order. These steps are jumbled. Put them in the correct order and read their numbers.

5 Run acid in until the indicator just changes colour.

1 Pipette 25.0 cm³ of alkali into a conical flask.

8 Read and record the final burette volume.

2 Add a few drops of indicator.

Ignore the rough run and any non-concordant titre. Door code = the mean titre $\times 100$, then the step numbers in order.

DOOR
CODE

KEY
DIGIT

Part 1. Classify each molecule as an alcohol or a carboxylic acid. alcohol = 1 · carboxylic acid = 2

C_2H_5OH

CH_3COOH

C_3H_7OH

$HCOOH$

Part 2. How many carbon atoms are in ethanoic acid, CH_3COOH ?

Esters. An ester is made from an alcohol + a carboxylic acid. How many oxygen atoms are in the ester group $-COO-$?

Alcohols contain $-OH$; carboxylic acids contain $-COOH$. Door code = the classifications, then the Part 2 answer, the ester answer.

DOOR
CODE

KEY
DIGIT

Each clue gives only a **type** of element. Exactly one element of that type is hidden in the grid – **find it**, then write the **chemical symbol** of each element (find iron → write **Fe**). Enter them in order 1–4 for the code.

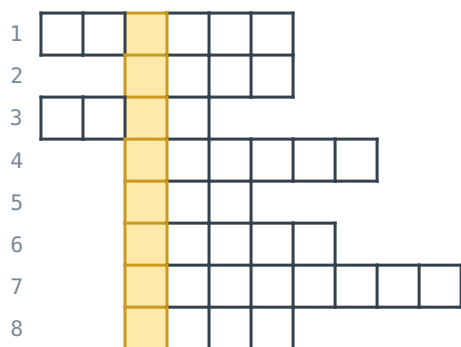
V	V	N	M	K	D	P	G	F	M	R	P	C
X	B	J	R	Z	X	M	G	W	U	N	U	M
L	R	E	D	I	N	M	A	V	I	V	R	H
T	O	J	B	S	T	U	Q	X	S	G	Q	M
Y	M	Z	K	Y	Z	I	M	E	S	W	N	U
V	I	O	X	T	U	S	B	B	A	X	L	K
M	N	H	T	F	S	E	I	B	T	L	Z	U
E	E	D	I	I	H	N	O	L	O	P	R	D
V	F	C	L	Q	B	G	A	R	P	H	D	A
W	T	V	M	K	V	A	C	T	D	P	P	N
C	E	N	J	Q	N	M	V	F	A	G	I	X
R	B	Z	P	W	Y	X	M	T	Z	L	J	B
C	Q	Z	S	O	H	Z	M	S	K	H	E	L

1. An alkali metal
2. An alkaline earth metal
3. A transition metal
4. A halogen

CODE 1 2 3 4

The clue only tells you the group – the grid tells you which element it is.

Solve the clues, one letter per box. The **shaded column**, top to bottom, spells the vault password.



1. The alkane with two carbon atoms (6)
2. A substance with a pH below 7 (4)
3. Formed when an acid neutralises a base (4)
4. Gas that relights a glowing splint (6)
5. The state of matter that fills its container (3)
6. Sweet-smelling product of an alcohol + acid (5)
7. Makes up about 78% of the air (8)
8. Sodium chloride is common ____ (4)

Every answer crosses the shaded column at one letter.

DOOR
CODE

MASTER OVERRIDE

Every door green? Write your key digits in order, then enter the master code to escape.

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DOOR 1 DOOR 2 DOOR 3 DOOR 4 DOOR 5 DOOR 6 DOOR 7

MELTDOWN OVERRIDE: enter your key digits REVERSED - last door first.

Enter codes at: _____

YOU ESCAPED — BUT THE SYSTEM ISN'T CLEAR

Four command-level overrides remain: optional and hard. Solve any on paper, then enter the answer on the escape screen under **Command Challenges**.

🔒 CHALLENGE 1 THE SIGNAL

ELEMENTAL CIPHER

The system needs one command to stabilise. It is hidden in these nine element tiles.

Si h tile, find the element's **atomic number**, then turn it into a letter (**1 = A, 2 = B ... 26 = Z**). Read the letters as a command.

Type the command into **The Signal** on the escape screen.

A 500 cm³ flask is filled with clean, dry air.

Gas	% of clean, dry air
Nitrogen	78
Oxygen	21
Argon	~1
Carbon dioxide	0.04

1 What volume of **nitrogen** is in the flask? (cm³)

2 What volume of **oxygen** is in the flask? (cm³)

Enter the nitrogen volume then the oxygen volume into **Atmosphere**.

🔒 CHALLENGE 3 PERCENTAGE YIELD

REACTING MASS + YIELD

Industrial hydration of ethene makes ethanol: $\text{C}_2\text{H}_4 + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_5\text{OH}$.

A_r : C = 12 · H = 1 · O = 16

1 What is the **maximum (theoretical) mass** of ethanol from **28 g** of ethene? (g)

2 The reaction actually made **34.5 g** of ethanol. What is the **percentage yield**?

Enter the theoretical mass then the % yield into **Percentage Yield**.

CHALLENGE 4 AVOGADRO

PARTICLES TO MASS

A flask holds 1.204×10^{24} molecules of oxygen, O_2 .

$A_r: O = 16 \cdot \text{Avogadro constant} = 6.02 \times 10^{23}$ per mole

1 How many **moles** of O_2 are in the flask?

2 What is the **mass** of this oxygen? (g)

Enter the moles then the mass into **Avogadro**.

🔒 CHALLENGE 5 LOCKDOWN CORE

LIMITING REAGENT

The core mixes **8 mol of magnesium** with **3 mol of oxygen**: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$.

1 How many **moles of MgO** are produced?

2 How many **moles of the excess reagent** are left over?

Work out which reagent runs out first. Enter the MgO moles then the excess moles into **Lockdown Core**.