

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 PARTICLE THEORY

CENSUS

These elements were logged. Work through them one at a time.

Br	Hg	I	H	N	O	Cl	Ne	Ar	Kr
Fe	C	P	K						

How many are **liquid at 25 °C**?

How many are **both a gas and diatomic**?

How many are **diatomic but not a gas**?

Code = the counts in that order. Careful: a solid can still be diatomic, and not every gas is diatomic.

DOOR
CODE

KEY
DIGIT

Part 1. Work out the structure of each substance from its properties.

ionic = 1 · simple molecular = 2 · giant covalent = 3 · metallic = 4

Sub.	m.p. / °C	Conducts (solid)	Conducts (molten)	In water	Other	Type
V	1710	no	no	insoluble	giant, glassy, hard	
W	770	no	yes	dissolves	crystalline salt	
X	-182	no	no	insoluble	colourless gas	
Z	1064	yes	yes	insoluble	soft, shiny metal	

Part 2. Give the **charge** (just the number) on the ion of each of these. You are expected to know them.

Astatide

Lead(II)

Iron(III)

Copper(I)

Door code = the structure types, then the ion charges.

DOOR
CODE

KEY
DIGIT

Part 1. The metal samples, each with an **ID number**, were added to solutions of the others' sulfates (the columns). ✓ = a reaction, ✗ = none, · = not tested. The ID numbers are only labels.

ID ↓	1	2	5	7	8
1	—	✗	✗	✗	✗
2	✓	—	✗	✗	✗
5	✓	✓	—	·	✗
7	✓	✓	·	—	✗
8	✓	✓	✓	✓	—

Clue: in the same dilute acid, metal **5** fizzed harder than metal **7**.

Put the ID numbers in order from **most** to **least** reactive – that sequence is the code.

Part 2. Balance the reaction and read the coefficients left to right.



Door code = the reactivity IDs in order, then the coefficients.

DOOR
CODE

KEY
DIGIT

🔒 DOOR 4 RUSTING

RANKING

Every tube holds an identical iron nail. **Rank only the tubes that rust**, fastest first, and read their numbers in that order. Leave out any that will not rust at all.

TUBE 6

iron nail in salty water, open to the air

rank

TUBE 2

iron nail in rainwater, open to the air

rank

TUBE 7

iron nail in plain water, open to the air

rank

TUBE 4

iron nail in plain water, only half filled (little air)

rank

TUBE 1

iron nail in water, sealed under oil

rank

TUBE 3

tin-plated nail, coating intact, in salty water

rank

TUBE 5

iron nail in water with a drying agent, sealed

rank

Both water and oxygen are needed to rust; dissolved salt speeds it up. Watch for traps.

DOOR
CODE

KEY
DIGIT

A single flask holds **sand, iron filings, salt, water and propanol**. Recover **every** substance, pure and separate.

Choose the techniques you need and put them in the **order you would use them**. Some are decoys. Read the numbers in your chosen order.

2 Using a magnet

9 Filtration

6 Fractional distillation

4 Crystallisation

7 Simple distillation

1 Decanting

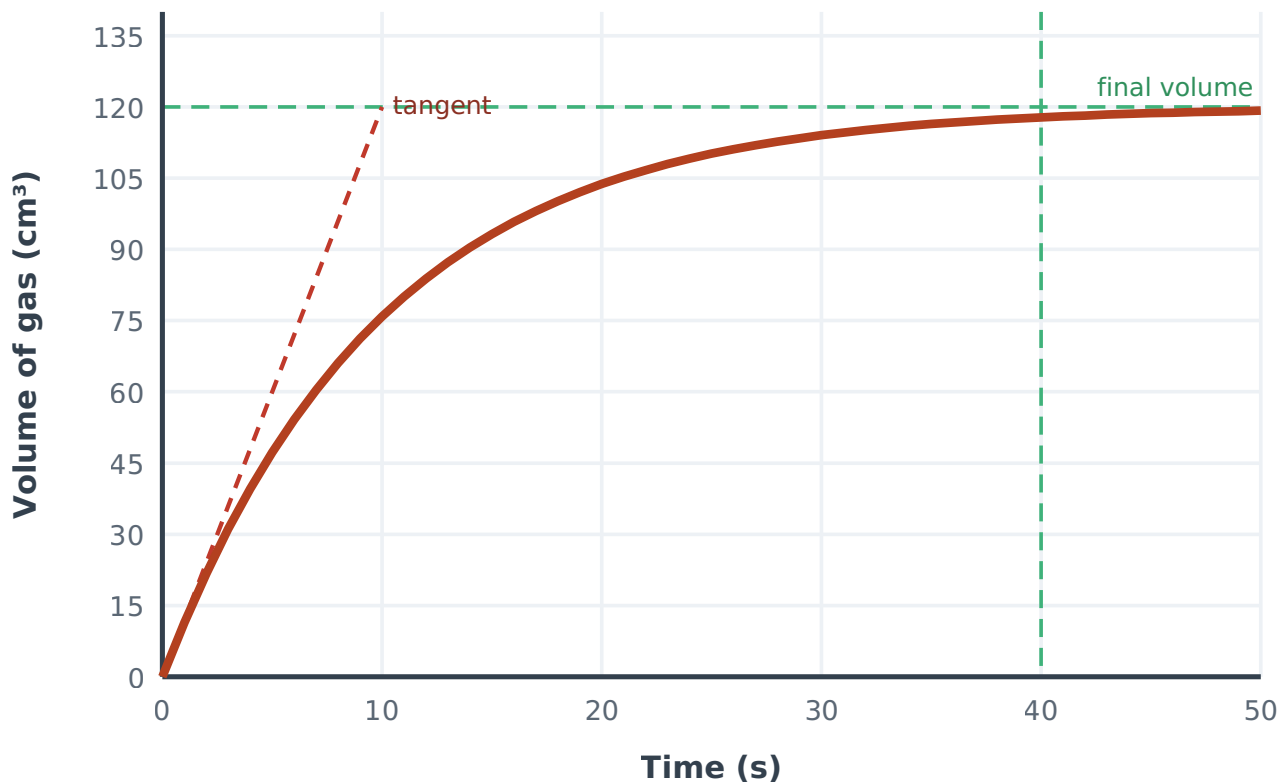
ORDER → →

Magnet first for the iron, then filter out the sand, then fractional distillation for the miscible liquids. Salt is left behind, dry.

DOOR
CODE

KEY
DIGIT

The graph shows the gas given off as marble chips react with dilute acid.



1 Initial rate: gradient of the tangent at $t = 0$, in cm^3/s

2 Average rate over the whole reaction, in cm^3/s

3 The run is repeated with **half** the concentration: the initial rate now, in cm^3/s

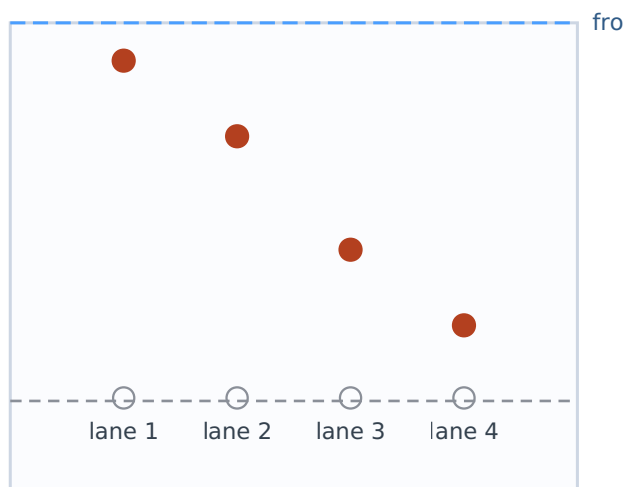
4 With half the concentration (acid limiting): the final volume now, in cm^3

Door code = the answers in order. The green lines mark the final volume and the time the reaction finishes. Read the tangent's gradient from two points on it.

DOOR
CODE

KEY
DIGIT

A chromatogram of the dyes is shown, **printed to scale**. The dashed lines are the baseline (bottom) and the solvent front (top).



$$R_f = \text{distance the dye rose} \div \text{distance the solvent rose}$$

Measure with a ruler. For each lane, measure how far the spot rose from the baseline and how far the solvent front rose, work out R_f , then **$\times 10$ and round to the nearest whole number**. Read the numbers from lane 1 to lane 4.

LANE 1

LANE 2

LANE 3

LANE 4

Round to a whole number so a millimetre out either way will not matter. Measure to the middle of each spot.

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.

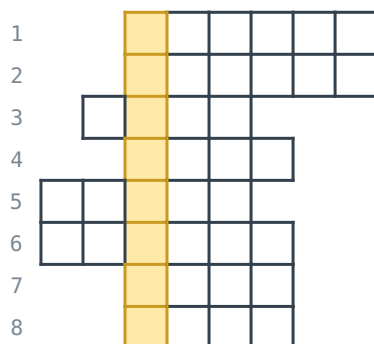
Z	C	T	U	S	I	I	K	X	N	Y	M	C
D	H	X	X	Y	P	Q	X	U	O	C	O	G
T	L	O	H	N	S	V	X	J	O	P	G	N
B	O	A	T	S	X	U	V	M	P	A	Z	Q
U	R	M	O	T	Z	L	P	E	D	Y	F	H
O	I	U	J	R	Y	J	R	B	U	B	B	I
W	N	I	X	T	E	V	T	S	E	J	G	P
C	E	C	U	M	E	T	V	P	F	U	X	O
G	I	L	K	U	U	F	Y	P	T	Z	J	X
R	Y	A	G	I	I	X	S	G	I	N	Z	H
S	F	C	L	D	V	L	G	E	C	S	N	K
V	F	E	N	O	X	S	H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

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 and write one letter per box. The **shaded column**, read from top to bottom, spells the vault password.



1. Element found in every organic compound (6)
2. A soluble base (6)
3. The smallest particle of an element (4)
4. pH below 7; turns litmus red (4)
5. A mixture of metals, such as brass (5)
6. Gas needed for both rusting and burning (6)
7. Formed when an acid neutralises a base (4)
8. A limewater ___ detects carbon dioxide (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.

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: _____

Command Challenges (optional finals), shared by all groups — answers: The Core → **SHUT IT DOWN** (atomic numbers to letters). Chain Reaction → **212** g (steps: 44, 2, 48, 4, 160, 212). The Unknown → **CaBr₂** (calcium + bromide; $0.025 : 0.05 = 1 : 2$). Deadlock → **57492** (1 iron, 2 sodium chloride, 3 copper(II) sulfate, 4 zinc, 5 calcium carbonate).