

## HOW TO ESCAPE

Pick your level, then work every part of a door to build its code. Type it into the terminal to open the door and reveal a key digit. Combine the key digits into the master override and escape.

**SAFE MODE** Set A · 5 doors · Support systems online.

### DOOR 1 PARTICLE THEORY

CENSUS

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

0

Fe

Br

He

Cu

Cl

Na

Hg

How many are **liquid at 25 °C**?

How many are **gases at 25 °C**?

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

DOOR  
CODE



KEY  
DIGIT

### DOOR 2 BONDING

STRUCTURE + CHARGES

**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 |
|------|-----------|------------------|-------------------|-----------|------------------|------|
| W    | 801       | no               | yes               | dissolves | brittle crystals |      |
| X    | 44        | no               | no                | insoluble | soft, low m.p.   |      |
| Z    | 1085      | yes              | yes               | insoluble | shiny, bends     |      |

Door code = the structure types, read in order.

DOOR  
CODE




KEY  
DIGIT

### DOOR 3 REACTIVITY SERIES

DEDUCTION

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

| ID ↓ | 1 | 4 | 7 |
|------|---|---|---|
| 1    | — | X | X |
| 4    | ✓ | — | ✓ |
| 7    | ✓ | X | — |

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

Door code = the ID numbers, most to least reactive.

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 2

strong salt water, open to the air

rank

### TUBE 8

weak salt water, open to the air

rank

### TUBE 5

plain water, open to the air

rank

### TUBE 9

plain water, boiled and sealed under oil

rank

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

DOOR  
CODE

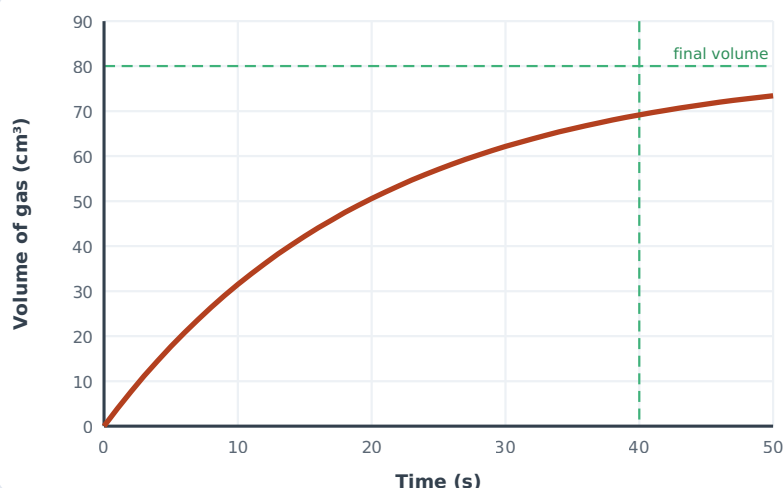
  

KEY  
DIGIT

## DOOR 5 RATES OF REACTION

READ THE CURVE

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



1 Final (maximum) volume of gas, in  $\text{cm}^3$

2 Average rate over the whole reaction, in  $\text{cm}^3/\text{s}$

Door code = the answers in order. The green lines mark the final volume and the time the reaction finishes.

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.

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

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 — SAFE MODE** 

Write each key digit, then enter your key digits in order, into the terminal.

## STANDARD Set A · 6 doors · Containment failing. Proceed with care.

### DOOR 1 PARTICLE THEORY

CENSUS

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

Hg

Br

O

N

Fe

C

Cl

Na

I

He

S

Ne

How many are **liquid at 25 °C**?

How many are **gases at 25 °C**?

How many are **diatomic molecules**?

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

DOOR  
CODE

KEY  
DIGIT

### DOOR 2 BONDING

STRUCTURE + CHARGES

**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 |
|------|-----------|------------------|-------------------|-----------|------------------|------|
| Y    | 3600      | no               | no                | insoluble | extremely hard   |      |
| W    | 801       | no               | yes               | dissolves | brittle crystals |      |
| Z    | 1085      | yes              | yes               | insoluble | malleable, shiny |      |

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

Sodium

Magnesium

Chloride

Aluminium

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

DOOR  
CODE

KEY  
DIGIT

## DOOR 3 REACTIVITY SERIES

DEDUCTION

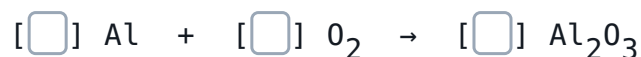
**Part 1.** The metal samples, each with an **ID number**, were added to solutions of the others' sulfates (the columns). ✓ = a reaction, X = none, · = not tested. The ID numbers are only labels.

| ID ↓ | 2 | 4 | 7 | 9 |
|------|---|---|---|---|
| 2    | — | X | X | · |
| 4    | ✓ | — | · | X |
| 7    | ✓ | · | — | X |
| 9    | · | ✓ | ✓ | — |

Clue: in the same dilute acid, metal **7** fizzed harder than metal **4**.

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 3

iron nail in 5% salt water, open to the air

rank

### TUBE 8

iron nail in 3% salt water, open to the air

rank

### TUBE 1

iron nail in 1% salt water, open to the air

rank

### TUBE 7

iron nail in plain water, open to the air

rank

### TUBE 5

iron nail in 5% salt water, boiled and sealed under oil

rank

### TUBE 9

galvanised (zinc-coated) nail in water, open to the air

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 **diamond grit, iron filings, common salt, water and ethanol**. 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.

1 Using a magnet

3 Filtration

2 Fractional distillation

7 Crystallisation

5 Simple distillation

9 Chromatography

ORDER  →  →

Two solids are trapped together – think what must come off first. Ethanol and water are fully mixed and boil only 22 °C apart.

DOOR  
CODE

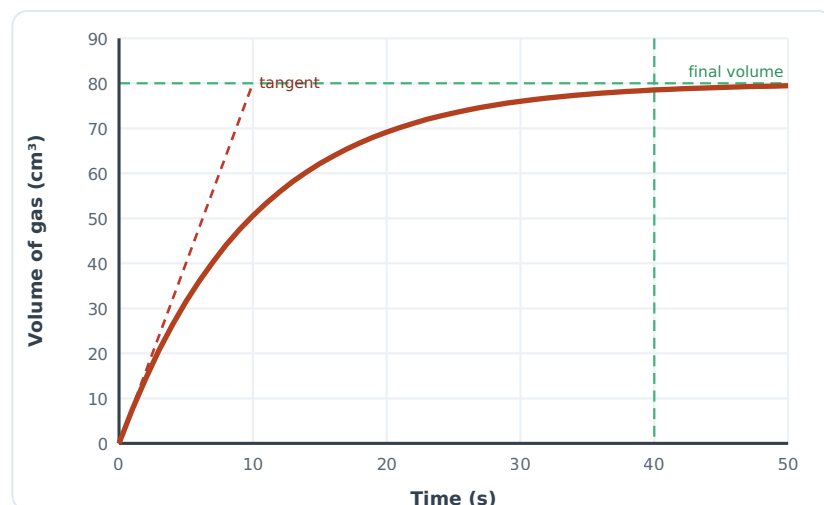
  

KEY  
DIGIT

DOOR 6 RATES OF REACTION

READ THE CURVE

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  $\text{cm}^3/\text{s}$

2 Average rate over the whole reaction, in  $\text{cm}^3/\text{s}$

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

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

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.

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

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 — STANDARD**



Write each key digit, then enter your key digits in order, into the terminal.

## MELTDOWN

Set A · 7 doors · Critical. Traps armed. Final code reversed.

### DOOR 1 PARTICLE THEORY

CENSUS

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

Hg

Br

I

O

N

Cl

F

He

Ne

Ar

Fe

C

S

Na

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

### DOOR 2 BONDING

STRUCTURE + CHARGES

**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    | 3600      | no               | no                | insoluble | giant, very hard |      |
| W    | 2852      | no               | yes               | dissolves | white solid      |      |
| X    | -101      | no               | no                | insoluble | green gas        |      |
| Z    | 1455      | yes              | yes               | insoluble | dense metal      |      |

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

Silver

Zinc

Chromium(III)

Manganese(IV)

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

DOOR  
CODE

KEY  
DIGIT

## DOOR 3 REACTIVITY SERIES

DEDUCTION

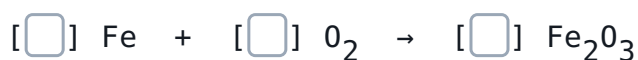
**Part 1.** The metal samples, each with an **ID number**, were added to solutions of the others' sulfates (the columns). ✓ = a reaction, X = none, · = not tested. The ID numbers are only labels.

| ID ↓ | 1 | 2 | 4 | 6 | 9 |
|------|---|---|---|---|---|
| 1    | — | · | ✓ | X | ✓ |
| 2    | · | — | X | X | X |
| 4    | X | ✓ | — | X | · |
| 6    | ✓ | ✓ | ✓ | — | ✓ |
| 9    | X | ✓ | · | X | — |

Clue: in the same dilute acid, metal **9** fizzed harder than metal **4**.

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 3

iron nail in salty water, open to the air

rank

### TUBE 6

iron nail in rainwater, open to the air

rank

### TUBE 1

iron nail in plain water, open to the air

rank

### TUBE 8

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

rank

### TUBE 5

iron nail in water, sealed under oil

rank

### TUBE 2

iron nail with a magnesium strip, in salty water

rank

### TUBE 9

galvanised nail in salty water, open to the air

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 **diamond grit, iron filings, salt, sand, water and ethanol**. 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.

5 Using a magnet

7 Filtration

3 Fractional distillation

1 Crystallisation

9 Simple distillation

2 Decanting

ORDER  →  →

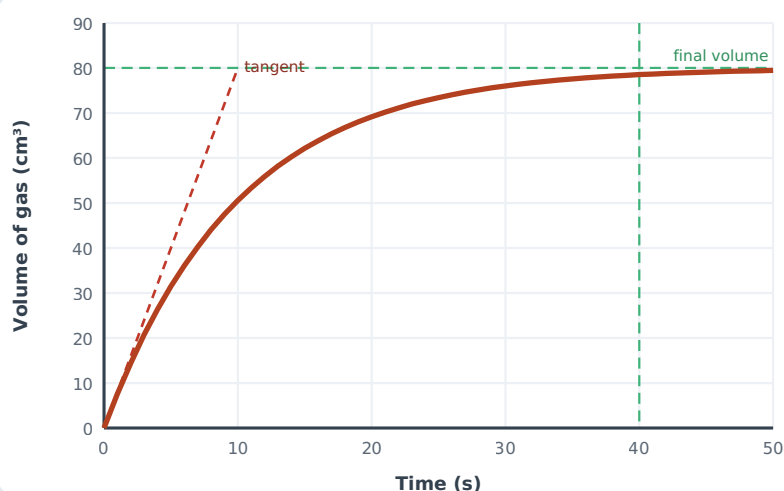
The magnet takes one solid; filtering removes the rest of the solids together; the miscible liquids need fractional distillation. Three techniques, in the right order.

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  $\text{cm}^3/\text{s}$

2 Average rate over the whole reaction, in  $\text{cm}^3/\text{s}$

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

4 With half the concentration (acid limiting): the final volume now, in  $\text{cm}^3$

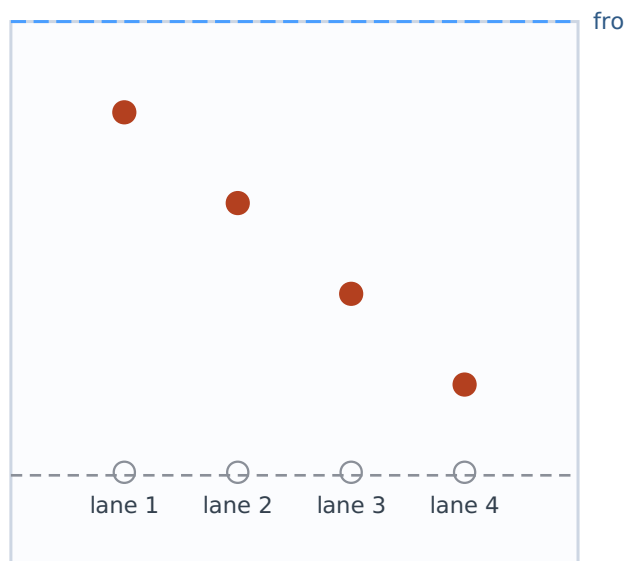
Door code = the answers in order. The green lines mark the final volume and the time the reaction finishes. Read the tangent's gradient from two points on it.

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

## BONUS OVERRIDE VAULT

WORD SEARCH

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.

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

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

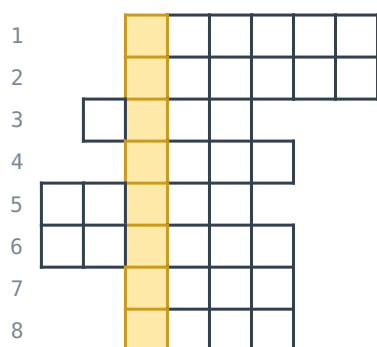
CODE

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

## BONUS II OVERRIDE VAULT

CROSSWORD

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 — MELTDOWN



Write each key digit, then enter your key digits **REVERSED** (last door first), into the terminal.