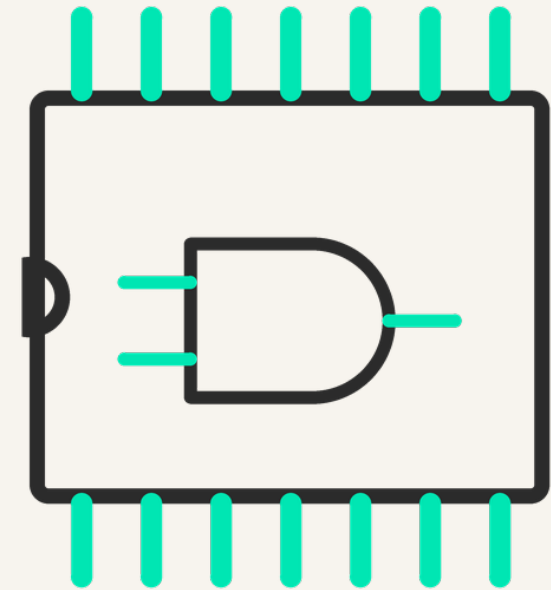


N5 ELECTRONICS • LOGIC

From Gates to Chips

Fourteen pins, four gates inside, and a data sheet you get to keep in the exam.

National 5 Practical Electronics



LEARNING INTENTION

To read a pin-out diagram and wire more than one gate from the same chip.

Daily Review

SHOW ME BOARDS

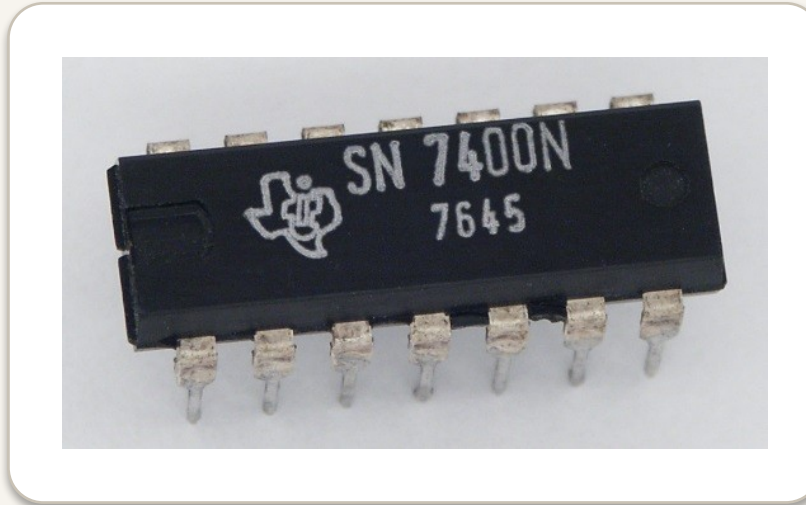
- 1 Name the three sections of a system.
- 2 The specification says 'either, or both'. Which gate?
- 3 What does 'active LOW' mean?
- 4 Which chip holds the AND gates?
- 5 A design combines three inputs. How many two-input gates?

By the end of this lesson...

- 1 I can read a pin-out diagram and find the pins of one gate.
- 2 I can use more than one gate from the same IC and wire them together.
- 3 I can explain what to do with the inputs of spare gates.

Inside the package

Booklet section 6. Gates arrive inside an integrated circuit.



A 14-pin dual-in-line (DIL) 7400 series IC.

- This course uses the 7400 series. Our chips are 74HC.
- Find pin 1 at the notch or dot; pins run anticlockwise from above.

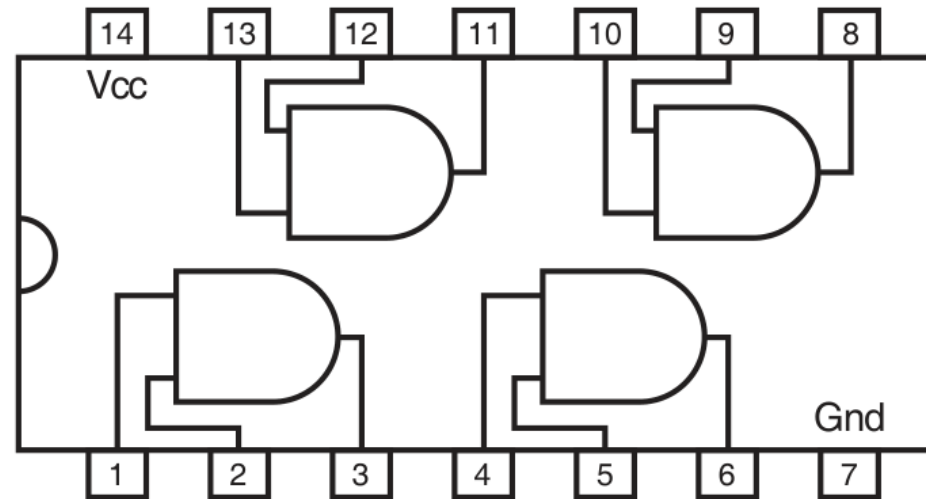
Facts you must know

Booklet section 6 — these come up every year.

	The fact
Supply	5 V in this course
Ground (Gnd)	always pin 7 on a 14-pin chip
Supply (Vcc)	always pin 14 on a 14-pin chip
A logic 1	the input must be above about 3.5 V
A logic 0	the input must be below about 1.5 V
Never	leave an input unconnected — a 74HC input does not settle

Reading a pin-out

Find the gate, then read its two inputs and its one output.

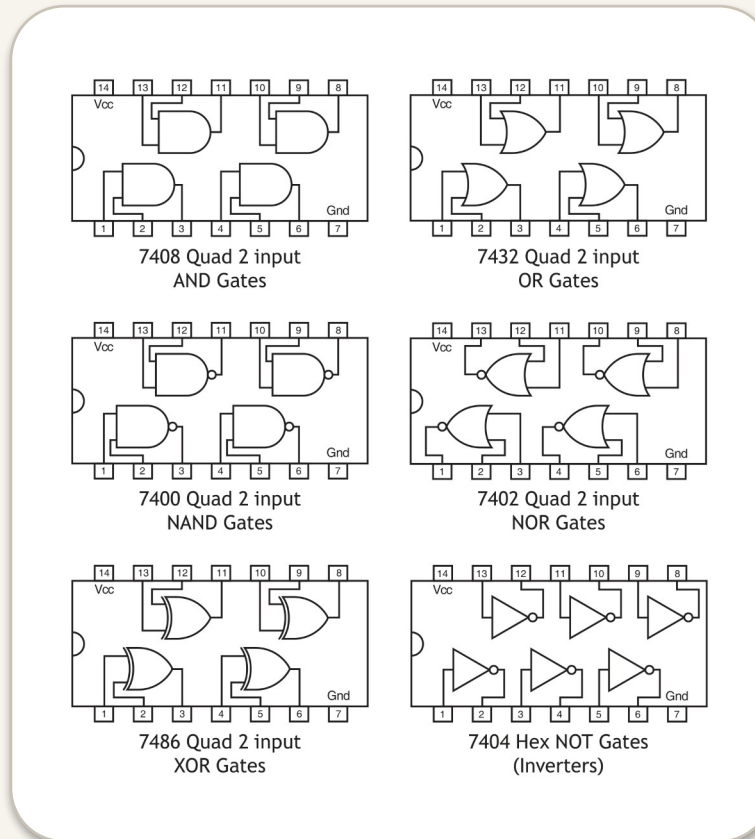


7408 Quad 2 input
AND Gates

The 7408. Gate 1 uses pins 1 and 2, with its output on pin 3.

All six are on the data sheet

You get this sheet in the exam. Learn to read it, not to memorise it.



The six chips, from the SQA National 5 data sheet.

Show Me — Find the pin

SHOW ME BOARDS

- 1 Data sheets out. On a 7400, which pin is +5 V?
- 2 On a 7486, which pin is 0 V?
- 3 On a 7408, which pins are the inputs of the FIRST gate?
- 4 On a 7432, which pin is the output of the THIRD gate?
- 5 How many gates are inside a 7400?

Find the pin

SHOW ME BOARDS

EXTRA PRACTICE

- 1 On a 7486, which pins are the inputs of the FOURTH gate?
- 2 On a 7400, which pin is the output of the third gate?
- 3 On a 7404, which pin is the output of the first inverter?
- 4 Which of the six chips holds gates with only one input?
- 5 Which chip's outputs come FIRST, before its inputs?

Your turn

Answer the six pin-out questions in TASK 3.
Use the data sheet. Do not guess from memory.

TASK 3 – Reading a pin-out

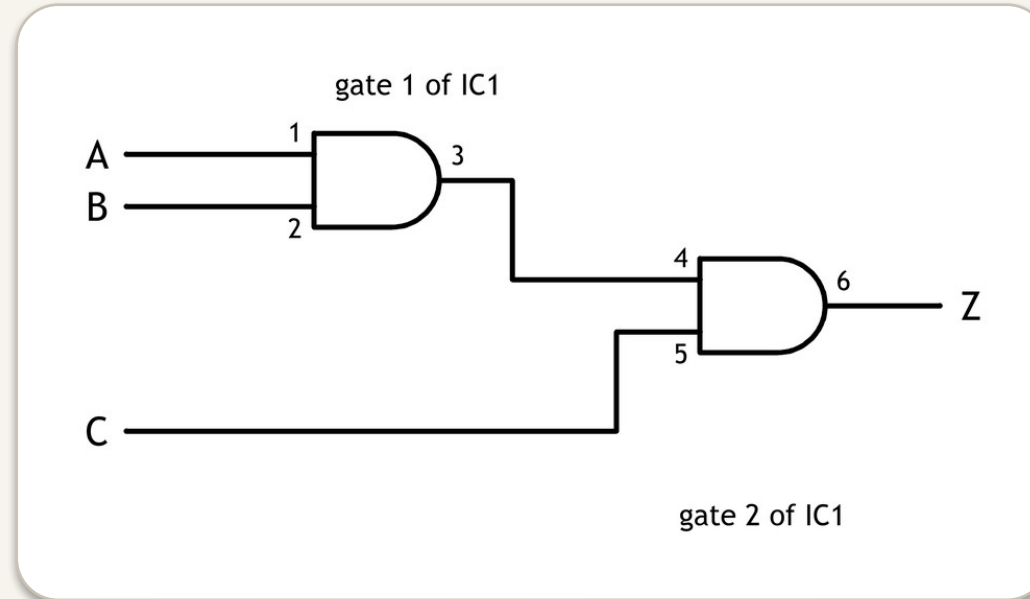
TASK 3 – Answers

Straight off the data sheet.

Question	Answer
Which pin is 0 V on a 7408?	pin 7
Which pin is +5 V on a 7432?	pin 14
On a 7408, the inputs of the second gate?	pins 4 and 5
On a 7408, the output of the second gate?	pin 6
How many NOT gates inside a 7404?	six
On a 7402, the output of the first gate?	pin 1 – the NOR chip is the odd one out

Two gates, one chip

A 7408 holds four AND gates, so a three-input AND needs only one chip.



Gate 1 combines A and B; pin 3 links to pin 4, so gate 2 adds C.

- Link the OUTPUT pin of gate 1 to an INPUT pin of gate 2.

Spare gates and unused inputs

Booklet section 6 — use two of four, and two are spare.

- Leave a spare gate's OUTPUT pin unconnected.
- Never connect an output to a supply rail — it damages the chip.
- Tie every unused INPUT pin to a rail. For a spare gate, 0 V.
- Using one input only? Tie the other one too:
- +5 V for an AND or NAND, 0 V for an OR or NOR.

Show Me — Spare gates

SHOW ME BOARDS

- 1 A design uses two of a 7408's gates. How many are spare?
- 2 What do you do with a spare gate's output pin?
- 3 What do you do with a spare gate's input pins?
- 4 Why must an output never go to a supply rail?
- 5 You use one input of an OR gate. Where does the other one go?

Spare gates

SHOW ME BOARDS

EXTRA PRACTICE

- 1 A design uses three of a 7404's inverters. How many are spare?
- 2 Which rail do spare gate inputs usually go to?
- 3 You use one input of a NAND gate. Where does the other one go?
- 4 What happens to a 74HC gate whose input is left floating?
- 5 Why is a floating input a safety problem for the chip itself?

Your turn

Core questions 1 to 7 in your jotter.
Then question 8 – going further.

PRACTICE – 7400 series ICs

PRACTICE – Answers

Core questions 1 to 7.

	Answer
1 Supply voltage of our 74HC chips	5 V
2 The pin connected to 0 V	pin 7
3 How pin 1 is identified	at the notch or dot; anticlockwise from above
4 Chips for three AND gates	one – a 7408 holds four gates (2)
5 Chips for two ORs and one NOT	one 7432 and one 7404 (2)
6 A spare gate's input pins	tie to a rail, usually 0 V – floating inputs drift (2)
7 Why solder a socket, not the IC	soldering heat can damage the chip

PRACTICE — Answers

Question 8 — going further. A four-input AND.

- Three two-input AND gates are needed. (1)
- Combine A and B; combine C and D; then combine those two. (1)
- All three gates fit in one 7408. (1)

Watch Out

Our chips are 74HC. Older books describe TTL and get these wrong.

THE MISTAKE

- An unconnected 74HC input settles at logic 1.
- Tie a spare gate's output to a rail as well.
- Solder the chip straight onto the stripboard.

THE CORRECT ANSWER

- It drifts. The gate heats up and switches at random.
- Leave the output unconnected. A rail would damage it.
- Solder a DIL socket, then push the chip in.

Checkpoint

SHOW ME BOARDS

- 1 On a 14-pin chip, which pins are 0 V and +5 V?
- 2 A design needs three AND gates. How many 7408 chips, and why?
- 3 Describe what to do with the inputs of a spare gate, and explain why.

LOOKING AHEAD

Switches and the logic probe

Next: how to wire a switch so the input never floats — and how to prove it with a probe.

Plenary

SHOW ME BOARDS

- 1 Which pin is 0 V on a 14-pin chip?
- 2 How do you find pin 1?
- 3 How many AND gates are inside a 7408?
- 4 What do you do with a spare gate's input pins?
- 5 How do you make a three-input AND from a 7408?

Plenary

SHOW ME BOARDS

EXTRA PRACTICE

- 1 Which pin is +5 V on a 14-pin chip?
- 2 Which way round do the pin numbers run?
- 3 How many inverters are inside a 7404?
- 4 What do you do with a spare gate's output pin?
- 5 Which chip would you order for two XOR gates?

Extension

- 1 A design needs five AND gates. How many 7408 chips, and why?
- 2 Why does the 7402 put its outputs on the lower-numbered pins?
- 3 Could one 7400 replace a 7408 and a 7404? Explain.

Extension

EXTRA PRACTICE

- 1 Why is a chip full of identical gates cheaper than mixed ones?
- 2 A design uses two chips. How many supply connections in total?
- 3 Why does the exam give you the data sheet rather than test recall?