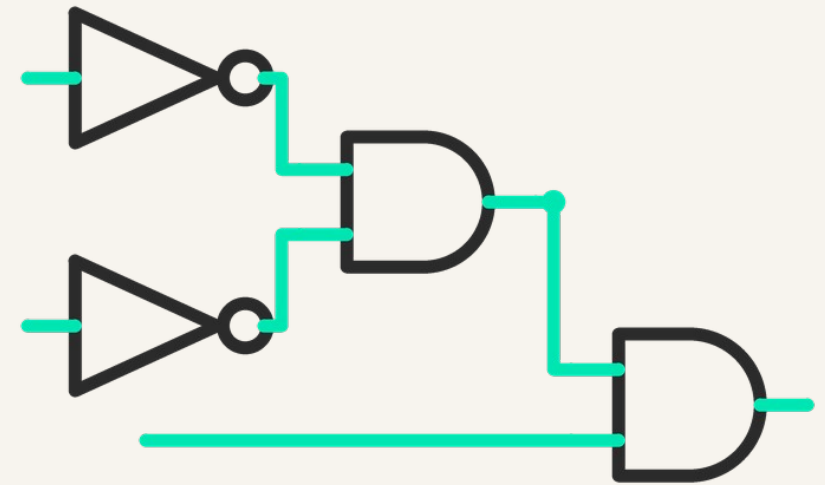


N5 ELECTRONICS • LOGIC

More Design Practice

A button that reads 0 when you press it, and a system with two outputs.

National 5 Practical Electronics



LEARNING INTENTION

To solve harder design problems, including active-low inputs and systems with two outputs.

Daily Review

SHOW ME BOARDS

- 1 Name the three sections of a system.
- 2 The specification says 'both'. Which gate?
- 3 The specification says 'different'. Which gate?
- 4 You want an input's condition to be logic 0. What do you add?
- 5 A design combines three inputs. How many two-input gates?

By the end of this lesson...

- 1 I can handle an input that is active LOW.
- 2 I can design a system with two outputs.
- 3 I can combine three inputs using two-input gates only.

Active LOW inputs

Some real sensors give logic 0 when the thing you care about happens.

- A fridge door switch reads 0 while the door is shut.
- You want the alarm when the door is OPEN — that is 1.
- So this one needs no inverter: the wanted condition is already 1.
- Now flip it. If it read 0 when OPEN, you would add a NOT gate.
- Always ask: what logic state is the condition I want?

Show Me — Active LOW

SHOW ME BOARDS

- 1 A button gives 0 when pressed. What does it give when released?
- 2 You want to act when that button is pressed. What must you add?
- 3 Why does an active-LOW input need an inverter?
- 4 Two active-LOW buttons must both be pressed. How many NOT gates?
- 5 After the NOT gate, which gate combines them?

Active LOW

SHOW ME BOARDS

EXTRA PRACTICE

- 1 A guard switch gives 0 when the guard is closed. Is that active LOW?
- 2 You want to act when the guard is closed. What do you add?
- 3 A sensor gives 1 when a tank is full. You want 'not full'. What now?
- 4 Which chip holds the inverters you would need?
- 5 How many inverters are inside that chip?

Two outputs

Two outputs is the most the course allows — and one input can drive both.

- A car indicator lever has one input and two lamps.
- The left lamp and the right lamp each get their own gate.
- Both gates are fed from the same lever input.
- Mark the junction with a dot. Label the outputs Y and Z.

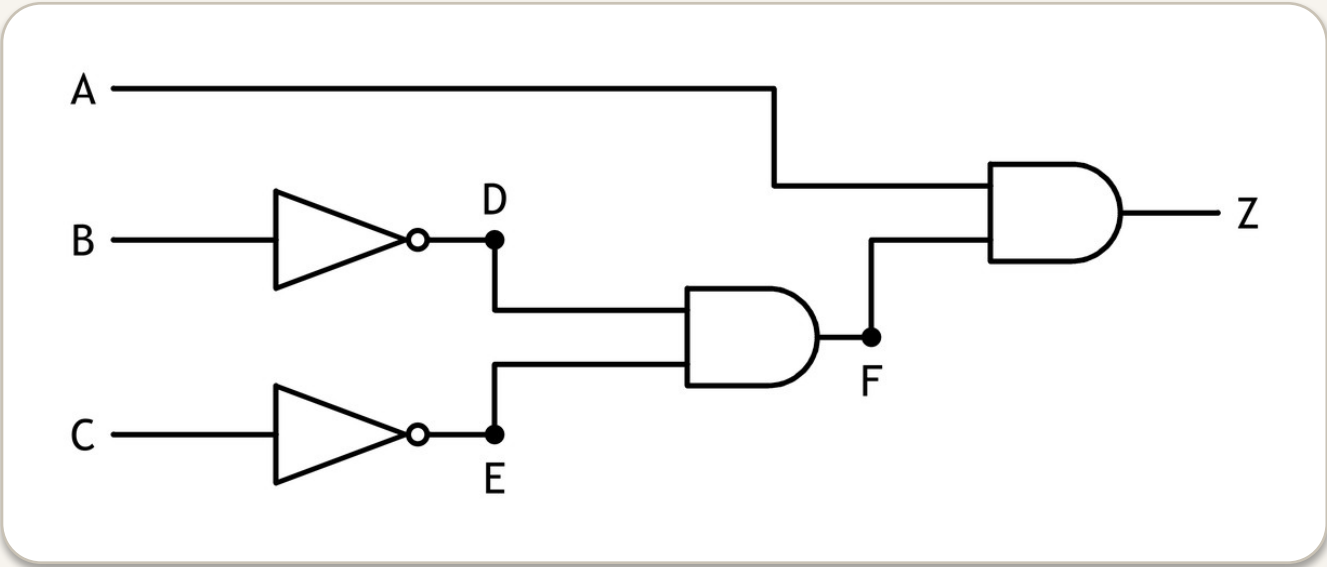
Your turn

Work Problems 4 to 7 through the six steps.
Problem 4: the paddle buttons give 0 when pressed.
Problem 7 has TWO outputs – call them Y and Z.
Check each design in Yenka for part (d).

Problems 4 to 7

Problem 4 – Answers

D and E are the two inverters; F combines them; Z adds A.

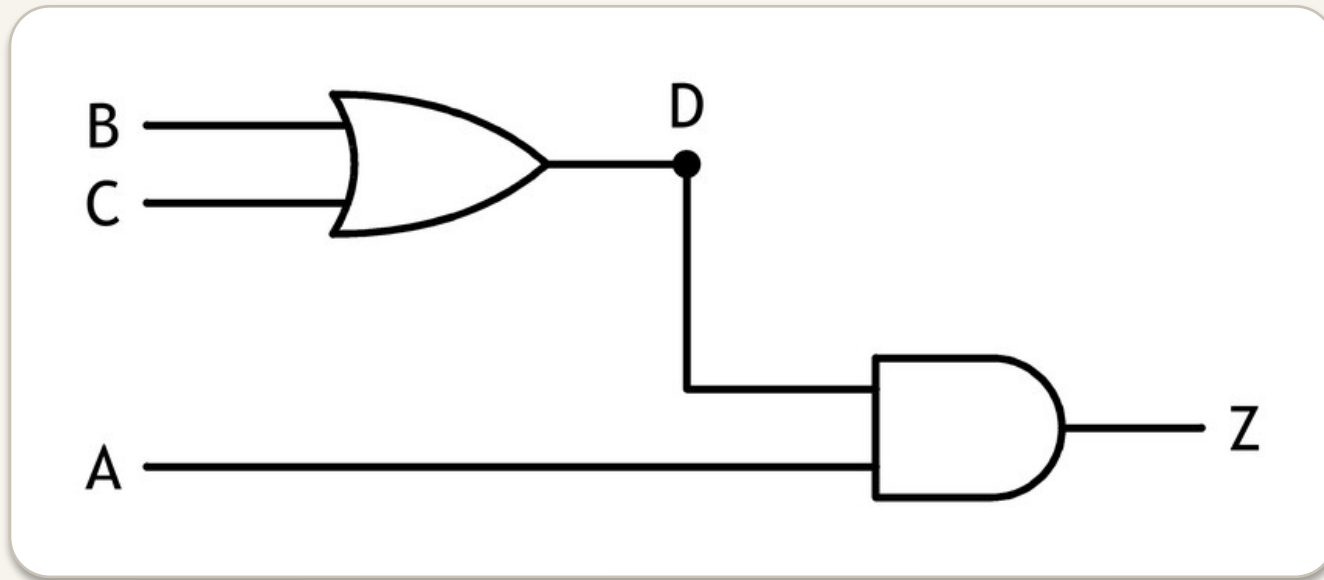


Two NOTs (7404) and two ANDs (7408).

A	B	C	D	E	F	Z
0	0	0	1	1	1	0
0	0	1	1	0	0	0
0	1	0	0	1	0	0
0	1	1	0	0	0	0
1	0	0	1	1	1	1
1	0	1	1	0	0	0
1	1	0	0	1	0	0
1	1	1	0	0	0	0

Problem 5 – Answers

D is the OR gate on B and C. Read it as: high rainfall AND either of the other two.

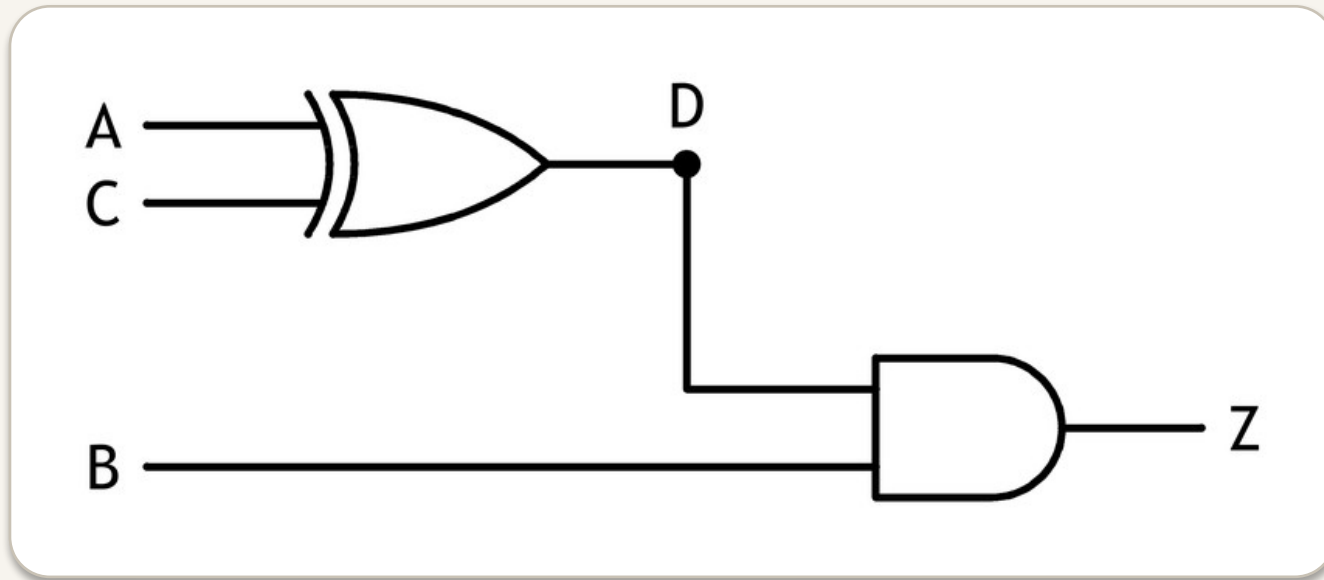


One OR (7432) and one AND (7408).

A	B	C	D	Z
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

Problem 6 – Answers

D is the XOR gate – logic 1 when the two light sensors disagree.

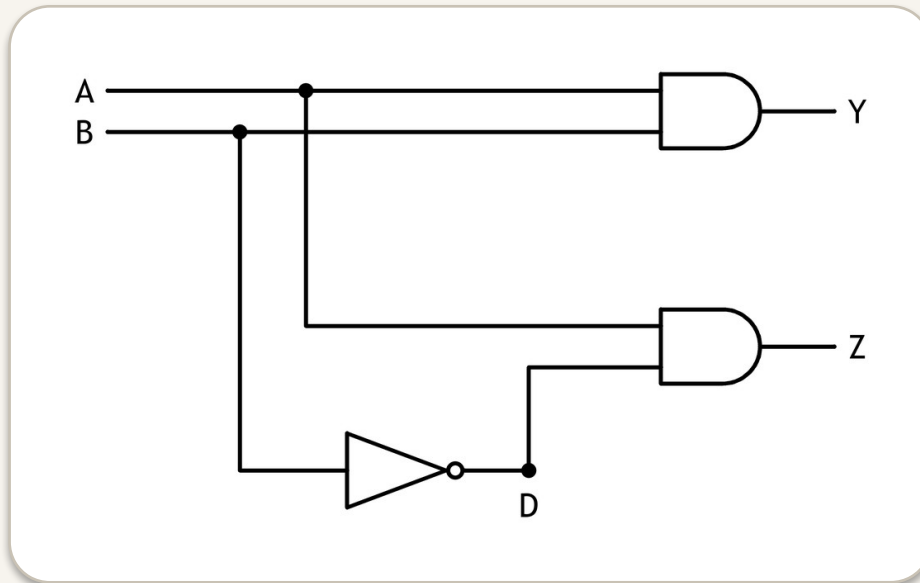


One XOR (7486) and one AND (7408).

A	B	C	D	Z
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	1	0
1	0	1	0	0
1	1	0	1	1
1	1	1	0	0

Problem 7 – Answers

D is the NOT gate on B. Input A feeds both output gates.



A	B	D	Y	Z
0	0	1	0	0
0	1	0	0	0
1	0	1	0	1
1	1	0	1	0

One NOT (7404) and two ANDs from one 7408.

Watch Out

THE MISTAKE

- A pressed button always means logic 1.
- 'Rainfall high and either of the others' means $(A \text{ AND } B) \text{ OR } C$.
- Two outputs need two separate circuits.

THE CORRECT ANSWER

- An active-LOW button gives 0 when pressed. Invert it.
- It means $A \text{ AND } (B \text{ OR } C)$. Read the sentence aloud.
- One input drives both branches, from a junction dot.

Checkpoint

SHOW ME BOARDS

- 1 What does 'active LOW' mean?
- 2 A design has two active-LOW inputs that must both be pressed. Name every gate you need, and say why.
- 3 How many outputs may an N5 design have?

Exam Practice

Design questions. Bring the paper; the questions are not reproduced here.

Paper	Question	Marks	What it asks
N5 2024	10	6	Gallery security: block diagram from a list of elements
N5 2024	4 (b)	1	Name a gate from its ANSI symbol

- 1 What does an active-LOW input give when it is operated?
- 2 What do you add to an active-LOW input you want to act on?
- 3 Which gate means 'the two readings disagree'?
- 4 How many outputs may an N5 design have?
- 5 Which chip holds the NOT gates?

Plenary

SHOW ME BOARDS

EXTRA PRACTICE

- 1 An active-LOW button is released. What is its logic state?
- 2 How many inverters for two active-LOW inputs?
- 3 Which gate means 'either of these two'?
- 4 What marks the point where one input feeds two gates?
- 5 Which chip holds the XOR gates?

LOOKING AHEAD

From gates to chips

Next: the real thing. Fourteen pins, four gates inside, and a data sheet you get in the exam.

Extension

- 1 Problem 4 uses two NOT gates. How many chips does the whole design need?
- 2 Could Problem 6 be solved without an XOR gate? Sketch what you would use.
- 3 Problem 7 has two outputs. Could a third be added? Explain.

- 1 Why do real sensors so often turn out to be active LOW?
- 2 A design needs five inputs all at logic 1. How many AND gates?
- 3 Two designs share the same inputs. Could they share one chip?