National 5
coursework
assessment task

Qualifications Scotland
Teisteanasan Alba

National 5 Engineering Science Assignment

Assessment task: Airport

Valid for session 2025-26 only.

This assessment is given to centres in strictest confidence. You must keep it in a secure place until it is used.

This edition: January 2026 (version 1.0)

© Qualifications Scotland 2026

Contents

Introduction 1

Instructions for teachers and lecturers 2

Instructions for candidates 5

Introduction

This document contains instructions for teachers, lecturers, and candidates for the National 5 Engineering Science assignment. It must be read in conjunction with the course specification.

There is an additional document that contains all the worksheets for this assignment.

This assignment has 50 marks out of a total of 160 marks available for the course assessment.

This is one of two course assessment components. The other component is a question paper.

Whilst this document contains ‘instruction for teachers and lecturers’ and ‘instructions for candidates’, everything in the document can be given to candidates.

Instructions for teachers and lecturers

This assignment is valid for the current session only.

Assessment conditions

You must conduct the assignment under a high degree of supervision and control. This means:

- all candidates must be within your direct sight
- candidates must not interact with each other
- candidates must not have access to email, the internet or mobile phones
- candidates must complete their work independently — no group work is permitted
- classroom display materials that might provide assistance must be removed or covered
- there must be no interruption for learning and teaching
- candidates must be in a classroom environment

Duration

Candidates have 8 hours to complete the assignment, starting at an appropriate point in the course after all content has been delivered. Once candidates begin their assignment, they must continue in each subsequent class period until the permitted time allocation has been used up.

You have a responsibility to manage candidates' work, distributing it at the beginning and collecting it at the end of each class period, and storing it securely in-between. This activity does not count towards the total time permitted for candidates to complete the assignment.

Resources

This is a closed-book assessment. Candidates must not have access to learning and teaching materials, the internet, notes, exemplar materials, resources on classroom walls or anything similar.

A Data Booklet containing relevant data and formulae is available on the National 5 Engineering Science subject page on Qualification Scotland's website. This can be used for the assignment.

Each assessment task includes instructions and details of any equipment or materials required for the assignment. Candidates can also use normal classroom equipment, software and hardware (such as drawing instruments, pneumatics, mechanisms and electronics kit, simulation software, and PCs to run the software) to complete the tasks.

There may be instances where restriction of internet and/or network use is not practical or feasible (for example, a local authority-managed IT network with specific limitations, software that is web-based, or something similar), however, it remains your professional responsibility to make every effort to meet the assessment conditions.

Alteration or adaptation

You must not alter, adapt or modify the assignment in any way — this includes moving the content into a different format. All candidates must undertake the assignment exactly as it has been provided by Qualifications Scotland.

Reasonable assistance

Candidates must progress through each stage of the assignment without your intervention or guidance, having acquired the skills needed earlier in the course.

Once candidates complete the assignment, you must not return it to them for further work. You must not provide feedback to candidates or offer your opinion on the perceived quality or completeness of the assignment response at any stage.

You can provide reasonable assistance to support candidates with the following aspects of their assignment:

- printing, collating and labelling their evidence to ensure it is in the format specified by Qualifications Scotland
- ensuring candidates have all the materials and equipment required to complete the assignment
- understanding the information outlined in these instructions

Artificial Intelligence

This is not permitted. Please see Qualification Scotland's website for more information, if needed.

Evidence

This assignment will be electronically marked from image (MFI), which means the following instructions must be followed. It is your responsibility to ensure that all candidate evidence (whether created manually or electronically) is:

- clear and easy to read (anything handwritten or drawn must be in blue or black permanent ink only)
- without anything else fixed to the pages (for example, photographs glued in place)
- labelled at the bottom to show the candidate's Scottish Candidate Number (SCN)
- compiled in task order with our flyleaf as the front cover
- printed or presented on A4 paper and secured with a single staple in the top left corner (prints can be single-sided or double-sided, however we prefer double-sided)

Each task must have a hard copy output (printed or hand-written) on the worksheets provided. This includes where the task asks them to simulate, construct, code, or similar.

Assignment

This assignment contains a number of tasks. Each task details:

- what the candidate must do (including any specific instructions on how the task must be carried out)
- how many pages of evidence are expected
- an anticipated duration

This ensures that candidates understand how to approach the tasks and do not produce too much or spend too long on a single task (whilst there is a time limit for the assignment, there is no page limit or page count).

Candidates can complete the tasks in the order presented or in an order that helps you manage classroom equipment and resources.

You must ensure that candidates are aware of the assessment conditions for the assignment, and that they understand what they should do for each task.

Instructions for candidates

This assignment has 50 marks out of a total of 160 marks available for the course assessment.

This is a closed-book assessment. Your teacher or lecturer lets you know how to carry out the assignment and they will go over the assessment conditions.

The assignment has a number of tasks and for each task you are provided with an engineering science context or situation.

In this assignment, you have to:

- analyse a problem
- design a solution to the problem
- build (simulate or construct) your solution
- test your solution
- evaluate your work

Unless otherwise instructed, you should complete tasks in the order presented.

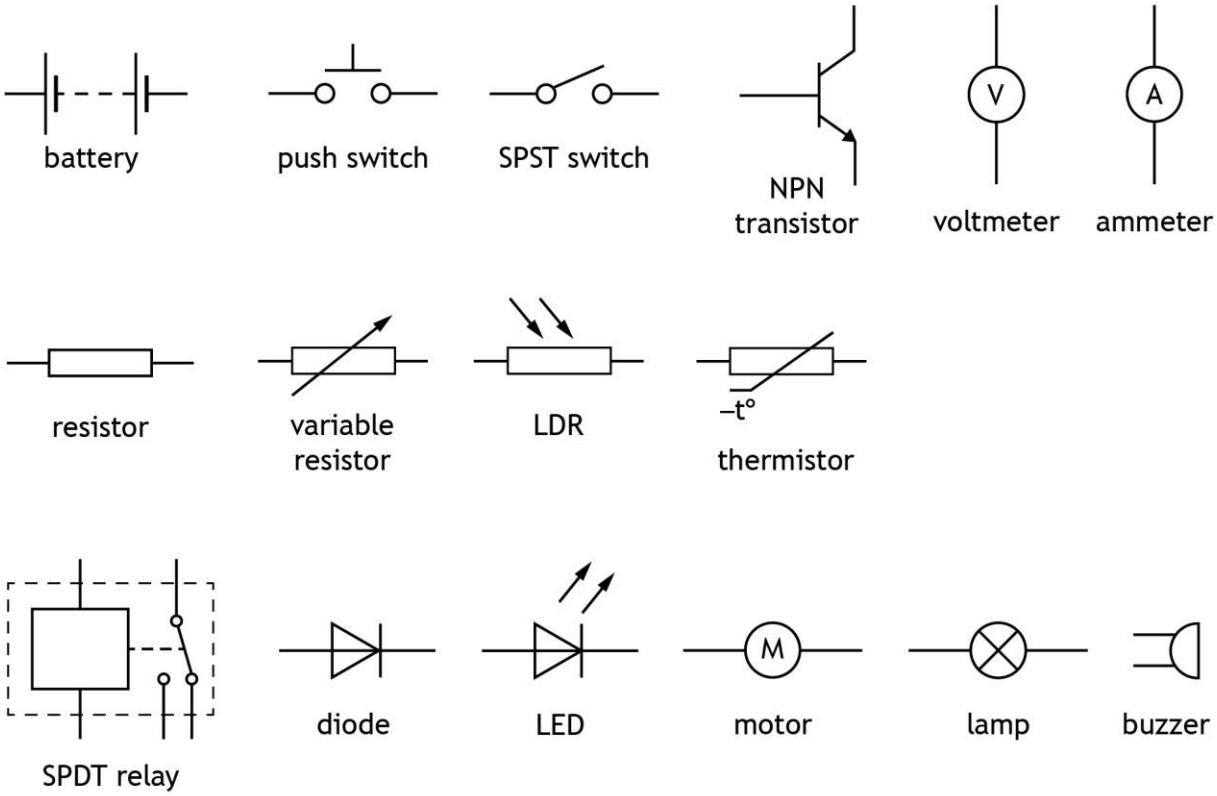
Each task must have a hard copy output (printed or hand-written) on the worksheets provided. This includes where the task asks you to simulate, construct, code, or similar.

You have 8 hours to complete the assignment. The time to set up and clear away any equipment you will need, and for any printing that is necessary, does not count towards the 8 hours.

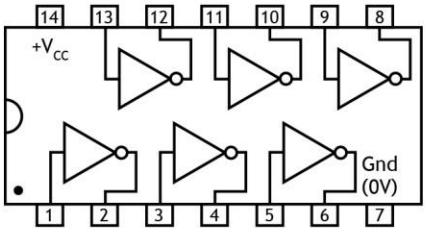
Data sheets — Airport

You can use these data sheets and Qualification Scotland's National 5 Engineering Science Data Booklet when completing this assignment. **No other resource material is permitted.**

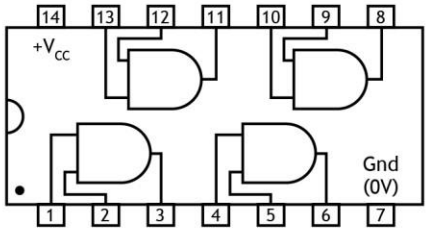
Electronic symbols



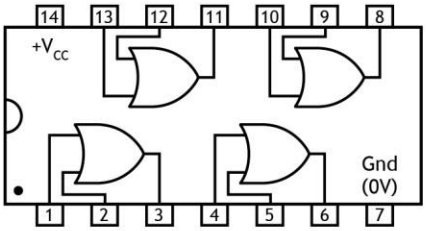
IC pinout diagrams



7404 hex inverter (NOT gates)

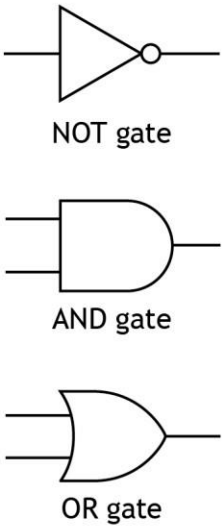


7408 quad 2 input AND gates



7432 quad 2 input OR gates

Logic gates



Pneumatic symbols

Actuators

spring return

pilot air

roller

solenoid

lever

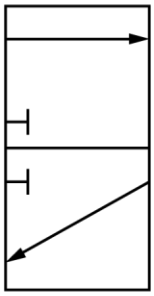
diaphragm

roller trip

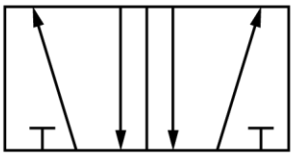
plunger

push button

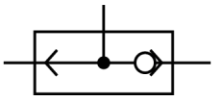
Valves



3/2 valve



5/2 valve



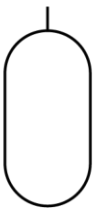
shuttle valve

main air

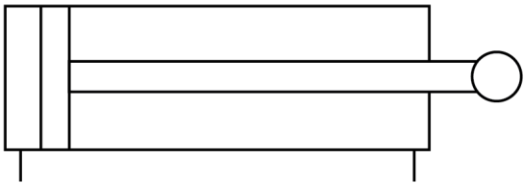
exhaust

Components and cylinders

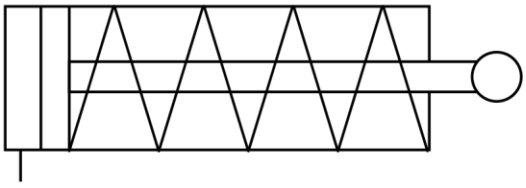
unidirectional restrictor



reservoir

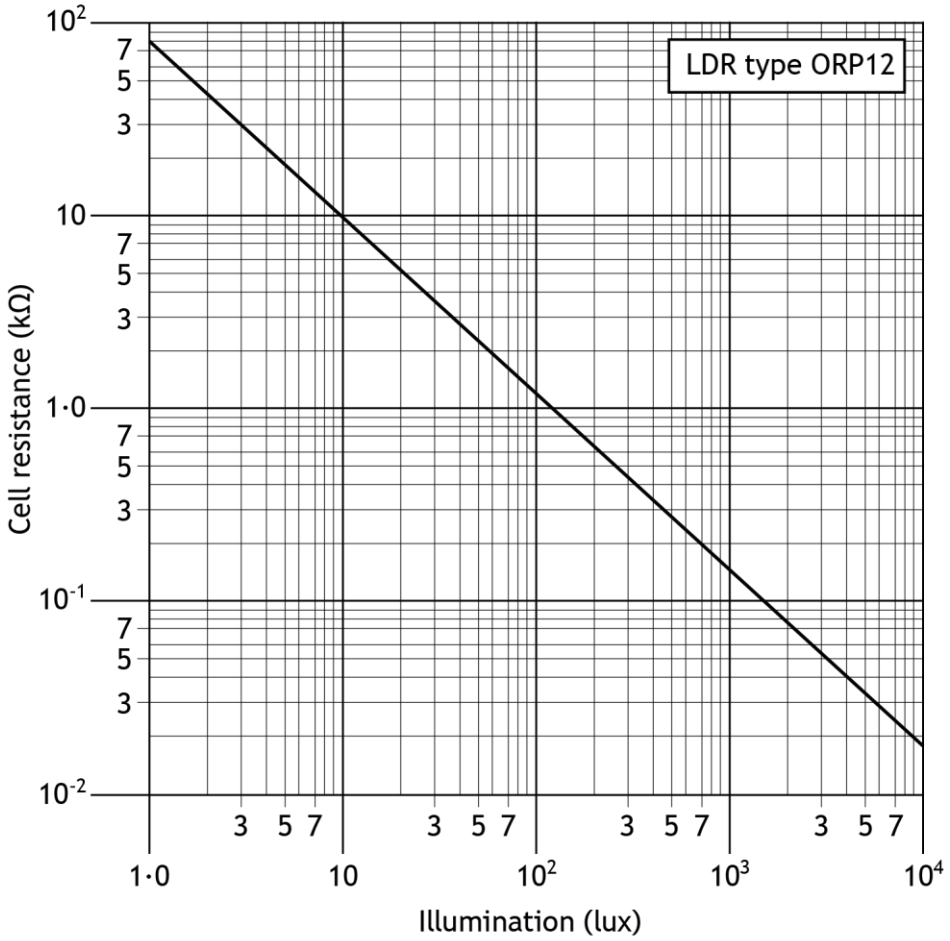


double-acting cylinder

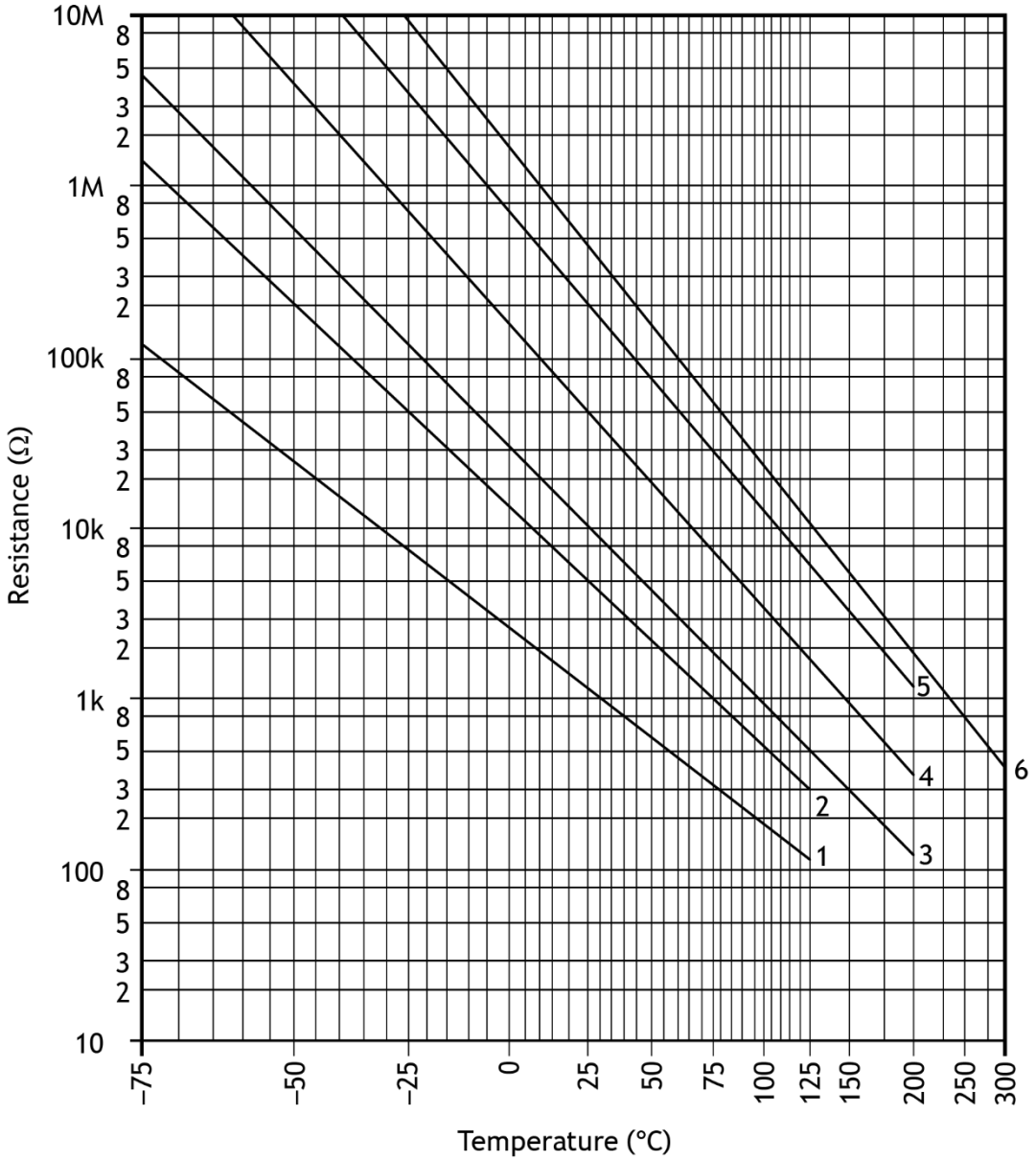


single-acting cylinder

Light Dependent Resistor (LDR) graph for an ORP12 LDR



Thermistor graph



Assignment — Airport

A team of engineers is involved in several tasks during the design of a new airport.

These tasks include developing proposals for the following systems:

- **Task 1** — automatic doors
- **Task 2** — overdoor heater
- **Task 3** — luggage wrapping machine
- **Task 4** — luggage check-in
- **Task 5** — luggage carousel

Task 1 — automatic doors

♦ Notional time: 2 hours 15 minutes
♦ Volume: completed on four worksheets

A pneumatic circuit is required to open a set of doors when a passenger is detected entering the terminal building and then close again once they are inside.

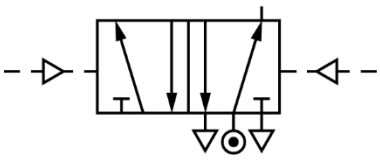
The pneumatic circuit must meet the following specification:

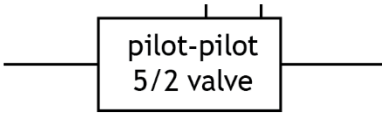
i. When an electrical actuator on a 3/2 valve receives a signal, a 5/2 valve will change state causing the pistons in two double-acting cylinders to outstroke.

ii. When an electrical actuator on a second 3/2 valve receives a signal, there should be an adjustable pneumatic delay before the 5/2 valve changes state causing both pistons to instroke slowly and smoothly.

1a Complete the design for the pneumatic circuit on **worksheet 1a**, to meet the specification.

You must identify the name of each component, valve, actuator, and indicate the direction of the piston outstroke. Show connections between all components and valves.
You can simplify components. For example, you could draw a 5/2 valve as shown below.





(5 marks)

Task 1 — automatic doors (continued)

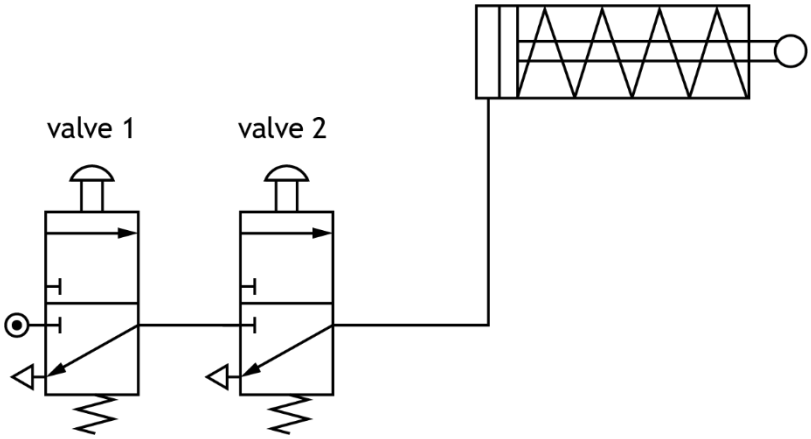
An improvement is required so that the doors will open when passengers are detected about to enter OR leave the terminal building.

The circuit must meet the following specification.

i. The piston must outstroke when only valve 1 is actuated.
ii. The piston must outstroke when only valve 2 is actuated.
iii. The piston must outstroke when both valve 1 and valve 2 are actuated.

Part of the re-designed circuit is shown below.

Note: For the purpose of testing, the 5/2 valve and double-acting cylinders have been replaced with a single-acting cylinder.



1b Simulate or construct the pneumatic circuit shown.

Alternative actuators on the 3/2 valves may be used.

Produce a hard copy output of your simulation or construction on **worksheet 1b**.

(2 marks)

1c Complete the testing table on **worksheet 1c**, by carrying out the given planned tests and then describing each test result.

(3 marks)

1d Evaluate the re-designed pneumatic circuit shown against the specification by completing the table on **worksheet 1d**.

You should state if each specification point is met and explain your decision.

(3 marks)

Task 2 — overdoor heater

♦ Notional time: 1 hours 15 minutes
♦ Volume: completed on three worksheets

An overdoor heater system is shown.

A system is needed to operate the overdoor heater which must meet the following specification:

i. When the system is switched on, a sensor will detect the outside temperature.
ii. Whenever a low temperature is detected a microcontroller will switch on a heater and an indicator lamp.

2a (i) Complete the system diagram on **worksheet 2a(i)** to meet the specification.

You must clearly show all external inputs and outputs.

(2 marks)

(ii) Complete the sub-system diagram on **worksheet 2a(ii)** to meet the specification.

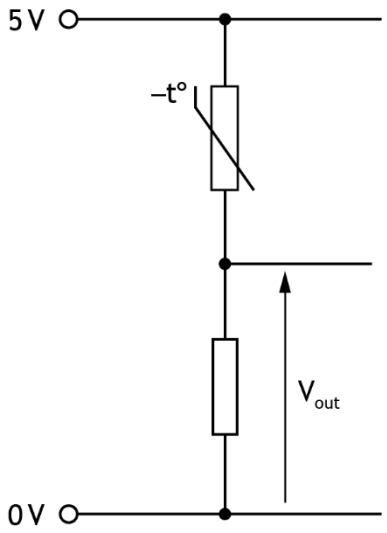
You must clearly show all external inputs and outputs from **task 2a(i),** all sub-systems, the system boundary and the interactions between sub-systems.

Note: Each output device requires a driver.

(6 marks)

Task 2 — overdoor heater (continued)

The input sensing circuit used to detect the outside temperature is shown.



The circuit must meet the following specification.

i. A suitable sensing component must detect a change in temperature.
ii. V_{out} should increase when the temperature decreases.
iii. V_{out} should be manually adjustable.

2b Evaluate the circuit against the specification by completing the table on **worksheet 2b**.

You should state if each specification point is met and justify your decision.

(3 marks)

Task 3 — luggage wrapping machine

♦ Notional time: 2 hours
♦ Volume: completed on four worksheets

Passengers can use a luggage wrapping service to help protect their suitcase and its contents.

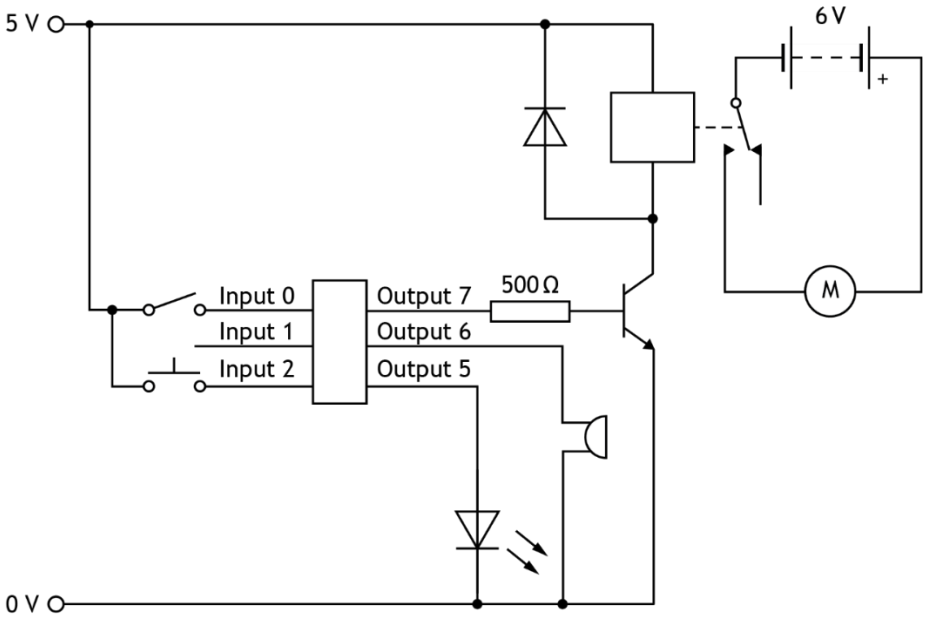
An electronic engineer has designed a microcontroller-based solution.

The input and output connections to the microcontroller are shown in the table below.

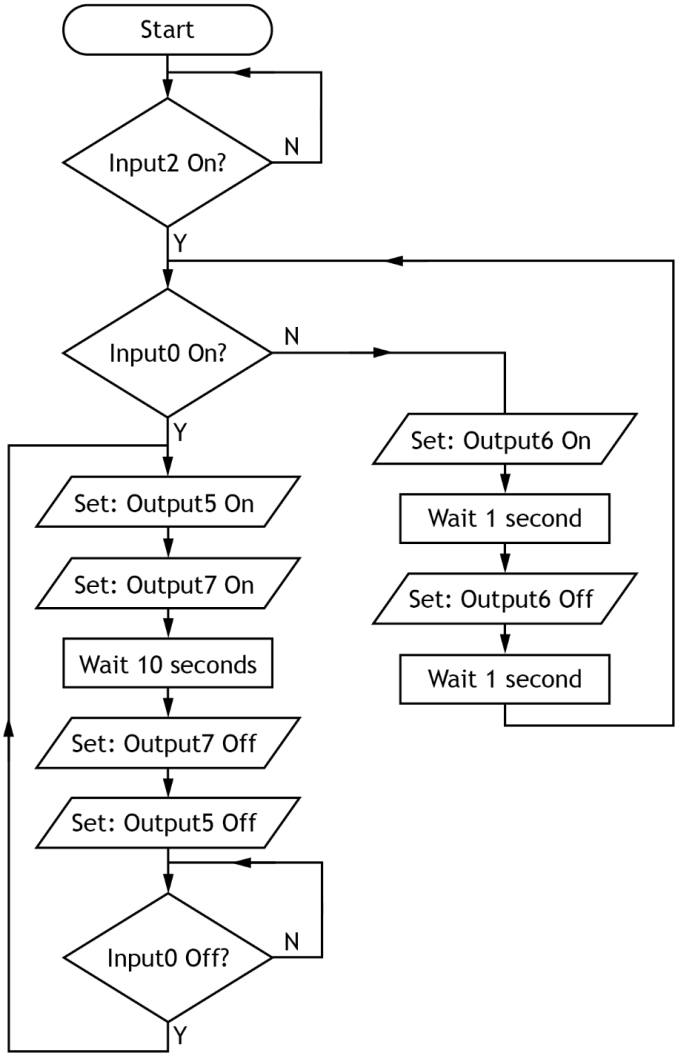
Input connections	Pin	Output connections
	7	motor
	6	buzzer
	5	LED
start switch	2	
luggage sensor switch	0	

Task 3 — luggage wrapping machine (continued)

The design for the electronic circuit and flowchart is shown below and on the following page.



Task 3 — luggage wrapping machine (continued)



Task 3 — luggage wrapping machine (continued)

3a Simulate the electronic circuit and flowchart sequence (on the previous pages) **integrated together as shown.**

An alternative microcontroller can be used but the pin numbers must match the connections given.

Note: for test purposes, the luggage sensor is replaced with an SPST switch.

Produce a hard copy output of your simulation on **worksheet 3a**.

(5 marks)

Task 3 — luggage wrapping machine (continued)

3b Produce high-level microcontroller code to match your completed flowchart in **task 3a**.

Produce a hard copy output of your code on **worksheet 3b**.

(1 mark)

The luggage wrapping service is operated by the microcontroller to meet the following specification:

i. The start switch is pressed to begin the process.
ii. If the luggage sensor does not detect a suitcase, the buzzer should sound for 1 second and then switch off for 1 second.
iii. When the luggage sensor detects a suitcase, the LED and motor should turn on.
iv. After 10 seconds, the LED and motor should turn off.
v. When the luggage sensor no longer detects the suitcase, the system should return to the start.

Errors were found in the electronic circuit and the flowchart during testing.

3c Complete the testing table on **worksheet 3c**, by carrying out the given planned tests and then describing each initial test result.

Describe your planned amendment, carry out your amendments to the flowchart and/or circuit as necessary to meet the specification. You must reset the system and repeat the previous test to allow the flowchart to progress, ready for the next test.

Describe the result of your re-test before moving onto the next test.

(4 marks)

Your final amended flowchart and electronic circuit should now meet the specification given above.

3d Simulate the final amended flowchart sequence and amended electronic circuit **integrated together.**

Produce a hard copy output of your simulation or construction on **worksheet 3d**.

(2 marks)

Task 4 — luggage check-in

- Notional time: 1 hour
- Volume: completed on three worksheets
- **You must not construct or use simulation software to complete task 4a**

A luggage check-in allows passengers to drop off their luggage.

The system uses a digital electronic control circuit.

4a Complete the logic diagram used in the luggage check-in process on **worksheet 4a**.

A conveyor motor (M) will turn on when a boarding pass (B) is scanned **or** personal information (P) is entered **and** a weight sensor (W) does **not** detect a suitcase that is too heavy.

Inputs/output	Logic condition
boarding pass (B)	pass scanned = 1
personal information (P)	information entered = 1
weight sensor (W)	too heavy = 1
conveyor motor (M)	on = 1

You must not construct or use simulation software to complete task 4a.

(3 marks)

4b Simulate or construct your logic diagram from **task 4a**.

You must include suitable input devices to allow for testing and label inputs B, P and W. If constructed, you must clearly label each integrated circuit (IC).

Produce a hard copy output of your simulation or construction on **worksheet 4b**.

(1 mark)

4c Test your simulated or constructed logic circuit from **task 4b** and complete the truth table on **worksheet 4c**.

(1 mark)

Task 5 — luggage carousel

♦ Notional time: 1 hour 30 minutes
♦ Volume: completed on four worksheets
♦ **You must not construct or use simulation software to complete task 5d**

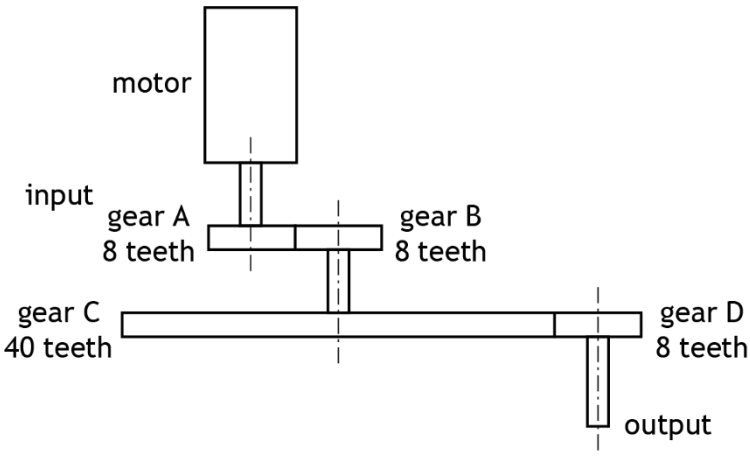
A luggage carousel that allows arriving passengers to collect their suitcases is shown.

A motorised gear train is used in the movement of the carousel.

The gear train must meet the following specification:

i. The output gear and input gear must turn in the same direction.
ii. The speed of the output must be reduced to achieve a velocity ratio that is between 7:1 and 12:1.

An initial design for the gear train, along with gear sizes, is shown below.



Task 5 — luggage carousel (continued)

5a Simulate or construct the initial gear train design.

You must include an input component to allow for testing and **label all gear sizes**.

Produce a hard copy output of your simulation or construction on **worksheet 5a**.

(2 marks)

5b Complete the test result table on **worksheet 5b** by carrying out the given planned tests and then:

- entering the results that you observed for the direction of the input and output gears for **task 5a** during simulation or after construction.
- recording the input and output speeds and calculating the actual velocity ratio.

(3 marks)

5c Evaluate the initial gear train design against the specification by completing the table on **worksheet 5c**.

You should state if each specification point is met and justify your decision.

(2 marks)

Following a design review, a second drive system is required.

5d Design a compound gear train that will decrease the speed at the output to achieve a velocity ratio that is between 15:1 and 25:1. You must label the input gear and include all gear sizes.

Produce a hard copy of your compound gear train on **worksheet 5d**.

You must not construct or use simulation software to complete task 5d.

(2 marks)

[END OF ASSIGNMENT]

Copyright acknowledgements

Task 1 – AlexandrBognat/shutterstock.com
Task 2 - Vladeep/shutterstock.com
Task 3 - ULU_BIRD/shutterstock.com
Task 5 - Arina P Habich/shutterstock.com

Administrative information

Published: January 2026

History of changes

Version	Description of change	Date

Security and confidentiality

This document can be used by practitioners in Qualifications Scotland approved centres for the assessment of National Courses and not for any other purpose.

This document may only be downloaded from Qualification Scotland's designated secure website by authorised personnel.

© Qualifications Scotland 2026