Candidate 1

Task	Max marks	Actual mark	Comments
1a	1	1	The simulation clearly shows the correct connections between the logic gates. Suitable input devices have been included.
1b	1	1	The results from testing are correct.
2a	5	4	A mark is awarded for the electronic components having been correctly selected and wired. No marks are awarded for the pins on the microcontroller as they have been labelled e.g. “motor”, which therefore does not match the design as shown. A mark is awarded for the selection of the correct flowchart symbols. A mark is awarded for the follow through error of the flowchart matching the labels on the microcontroller. A mark is awarded for the integration of the circuit and flowchart.
2b	5	4	Tests 1 and 2 – the actual results and amendments made are correct. No mark is awarded for the actual result in Test 3 as it describes what should happen rather than describing the actual result.
2c	2	2	The two amendments reflect the descriptions in **2b**.
2d	1	0	The code uses the incorrect syntax for testing the inputs. The outputs are also identified as 4 and 5, which does not match the flowchart in **2c**.
2e	4	1	There is no mention of any of the specification points being met. A mark is awarded for the strong evaluative comment on the effectiveness of the solution in the carwash environment.
3a	6	6	All pneumatic components have been identified and correctly connected. The time delay has been placed on the double acting cylinder outstroke pipe. This is acceptable, although not good practise.
3b	2	2	**Reason 1** Characteristic - “use in a wet environment” and justification -“will be used in a lot of water” while it is not a strong response it is an acceptable justification. **Reason 2** Characteristic -“non-contact method of sensing” and justification “you don’t have to get out of your car”.
4a	2	2	No input or output is labelled. However, they are implied in the calculation. The appropriate gear sizes are shown. Although the calculation is wrong it does not affect the marks awarded.

4b	2	1	A mark is awarded for simulating a compound gear train with an input device. No mark is awarded for the gear sizes, as they are different from the sketch in **4a.**
4c	1	1	Correct results from the evidence in **4b**.
4d	2	1	A mark is awarded for the description of specification point 1 being met and justified in terms of the speeds. No mark is awarded for the description of specification point 2 being met as the justification “gears are compacted” is not enough to achieve the mark.
5a	3	3	The correct components are correctly positioned and wired.
5b	6	6	All planned tests and expected results are correct. The third planned test describes altering both the variable resistor and the expected result is correct for this test.
6a	2	0	It is an incorrect diagram.
6b	5	2	A mark is awarded for the switch (sub system). Either, one mark is awarded for the system boundary (and ignore the lamps) **OR** one mark is awarded for the green lamp (and ignore the system boundary). No mark is awarded for the red lamp as the arrow points in both directions.
Total	**50**	**37**	

Candidate 2

Task	Max marks	Actual mark	Comments
1a	1	1	The simulation clearly shows the correct connections between the logic gates. Suitable input devices have been included.
1b	1	0	The truth table does not reflect the simulation in **1a**.
2a	5	5	All components, connections, symbols and pin numbers are correct with evidence of integration.
2b	5	3	Test 1: No mark is awarded for the actual result as it is incorrect based on the candidate's simulation in **2a**. In addition, neither component is referred to. A mark is awarded for the amendments based on the candidate's actual result. Test 2: No mark is awarded for the actual result, as the 5-second delay has not been referred to. A mark is awarded for the amendments. The description is very vague but, paired with the actual result and the evidence from **2c**, it is acceptable as it implies the correct the amendment. Test 3: A mark is awarded for the actual result referring to the sequence repeating.
2c	2	2	A mark is awarded for swapping the pin 7 off and pin 6 off flowchart symbols. A mark is awarded for reducing the value of the resistor protecting the LED to 500Ω. Although this was not described in **2b** it is a positive amendment from the candidate's circuit in **2a**.
2d	1	0	The pin numbers in the code (pins 5 and 4) do not match the pin numbers in the flowchart in **2c** (pins 7 and 6).
2e	4	0	No marks are awarded as no reference has been made to any of the specification points actually being met and there is no comment on the overall effectiveness of the system in the car wash environment.
3a	6	5	A mark is awarded for the double acting cylinder with the direction of outstroke shown, connected to 5/2 valve. No mark is awarded for the unidirectional restrictor missing on the exhaust to slow down the outstroke of the cylinder. A mark is awarded for the time delay in the correct position. A mark is awarded for the correct arrangement of the reservoir and Unidirectional restrictor to create an adjustable time delay. A mark is awarded for the 2 x 3/2 valves. A mark is awarded for the 2 x solenoid actuators.

3b	2	2	**Reason 1** Characteristic “use in a wet environment” and justification “it will get wet in a car wash” **Reason 2** Characteristic “non-contact sensor” and justification “useful in a wet environment” implying that the driver will not have to get wet.
4a	2	0	The diagram does identify the input and output but lacks enough detail (eg no shafts shown, all gears look like they are meshing) to justify that it is a compound gear train and that it will have a speed reduction of at least a factor of 25.
4b	2	1	A mark is awarded for the simulation of a compound gear train, showing the input. No mark is awarded for gear sizes, as they do not match the gear sizes from **4a**.
4c	1	1	Although the output speed is not exactly 1 (as evident in the graph in **4b**), it is assumed that the candidate has rounded up their output speed to nearest whole number.
4d	2	0	No reference has been made as to whether the specification points have been met.
5a	3	3	The correct components are correctly positioned and wired.
5b	6	2	Test 1: A mark is given for the planned test implying that the temperature is increased (“heats up”). The expected result is incorrect. Test 2: A mark is given for the planned test implying that the temperature is lowered (“allows the water to cool”). The expected result is incorrect. Test 3: Altering the variable resistor as well as adjusting the temperature is not described. The expected result is not described clearly enough.
6a	2	2	The correct input and outputs have been identified, with arrows. The limit switch can be ignored.
6b	5	0	“Button” is not an accepted response for the switch input. The drivers, lamps and system boundary are all missing.
Total	**50**	**27**	

Candidate 3

Task	Max marks	Actual mark	Comments
1a	1	1	The simulation clearly shows the correct connections between the logic gates. Suitable input devices have been included.
1b	1	1	The results from testing are correct.
2a	5	4	No mark for selection of components as the voltage of the battery is incorrect (showing as 5V instead of 6V). Although the two elements of the simulation are not on the same screen the same file name can be identified (just) in the top left of each screenshot therefore providing evidence of integration.
2b	5	5	The third actual result refers to the sequence “looping back” which, on its own, would not achieve a mark. However, the candidate has followed this with a description implying that it loops back to the start.
2c	2	2	The evidence clearly shows two amendments (the reduction of the resistor value to 270Ω and the swapping of the low 7 and low 6 commands).
2d	1	0	No marks were awarded, as there is incorrect programming in both the LED off and motor off lines “out %00000000”.
2e	4	1	The candidate has written that they tested “to make sure that all of the specification points were met” but they have not specifically described if the specification points were indeed met. A mark has been awarded for a good evaluative comment on the overall effectiveness of the solution referring to its suitability in the carwash environment.
3a	6	5	Components have been correctly identified using both symbols and names. The candidate could not gain full marks as they incorrectly positioned the unidirectional restrictor after the reservoir.
3b	2	0	No marks awarded as no characteristics have been selected from the list.
4a	2	2	A labelled compound gear train with suitable sizes of gears, to achieve the speed reduction of at least a factor of 25, has been correctly drawn.
4b	2	2	The simulation matches the design in **4a** and the input is identified by both its label and by the inclusion of a motor.
4c	1	1	The evidence from **4b** provides evidence of simulation and this result reflects the values given from **4b**.
4d	2	2	Both specification points are referred to as being met with sufficient justifications.
5a	3	3	Both symbols are correctly drawn and positioned.

5b	6	5	In the second expected result, “low” is acceptable to infer the lamp switching off. No mark is awarded for the third planned test which refers to testing the “sensitivity of thermistor”, which is incorrect. The response also does not describe adjusting the variable resistor and adjusting the temperature.
6a	2	2	The car, green light and red light are all correctly positioned with arrows. “Heat” is ignored.
6b	5	3	The limit switch and drivers are correctly positioned and the system boundary is present. The candidate incorrectly states red and green LEDs instead of lamps.
Total	**50**	**39**	