



National 5
Coursework
Assessment Task



National 5 Engineering Science Assignment Finalised Marking instructions

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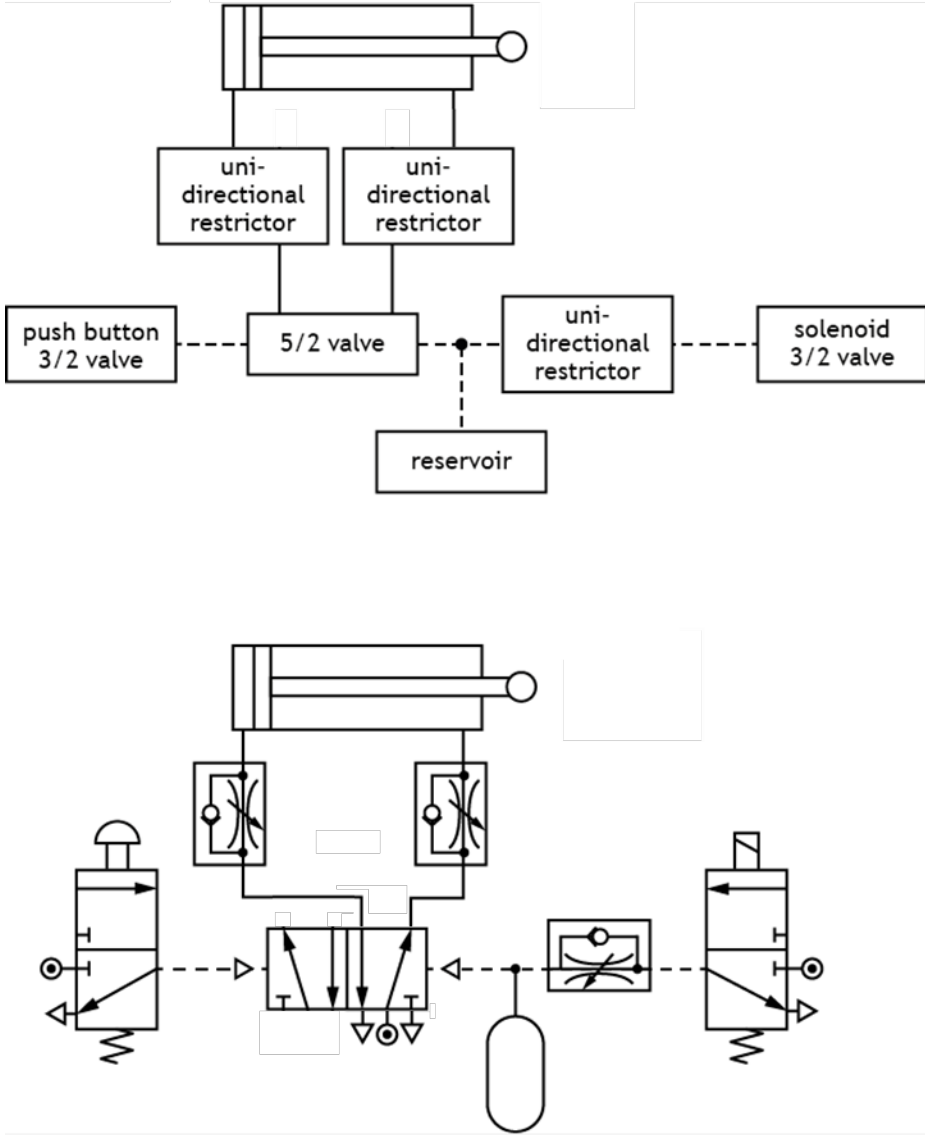
General marking principles

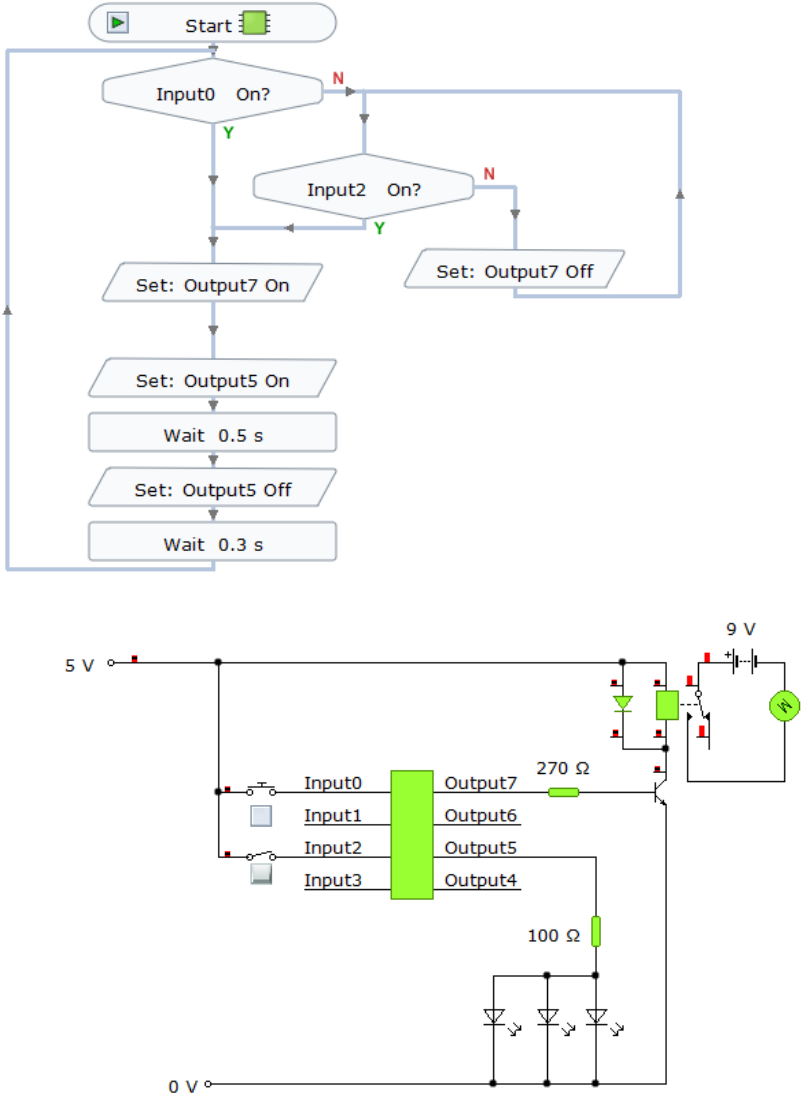
This information is provided to help you understand the general principles that must be applied when marking candidate responses in this assignment. These principles must be read in conjunction with the detailed/specific marking instructions, which identify the key features required in candidate responses.

- a Marks for each candidate response must always be assigned in line with general marking principles and the specific marking instructions for this assessment.
- b Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.
- c If a specific candidate response is not covered by either the general marking principles or detailed marking instructions, you must seek guidance from your team leader.

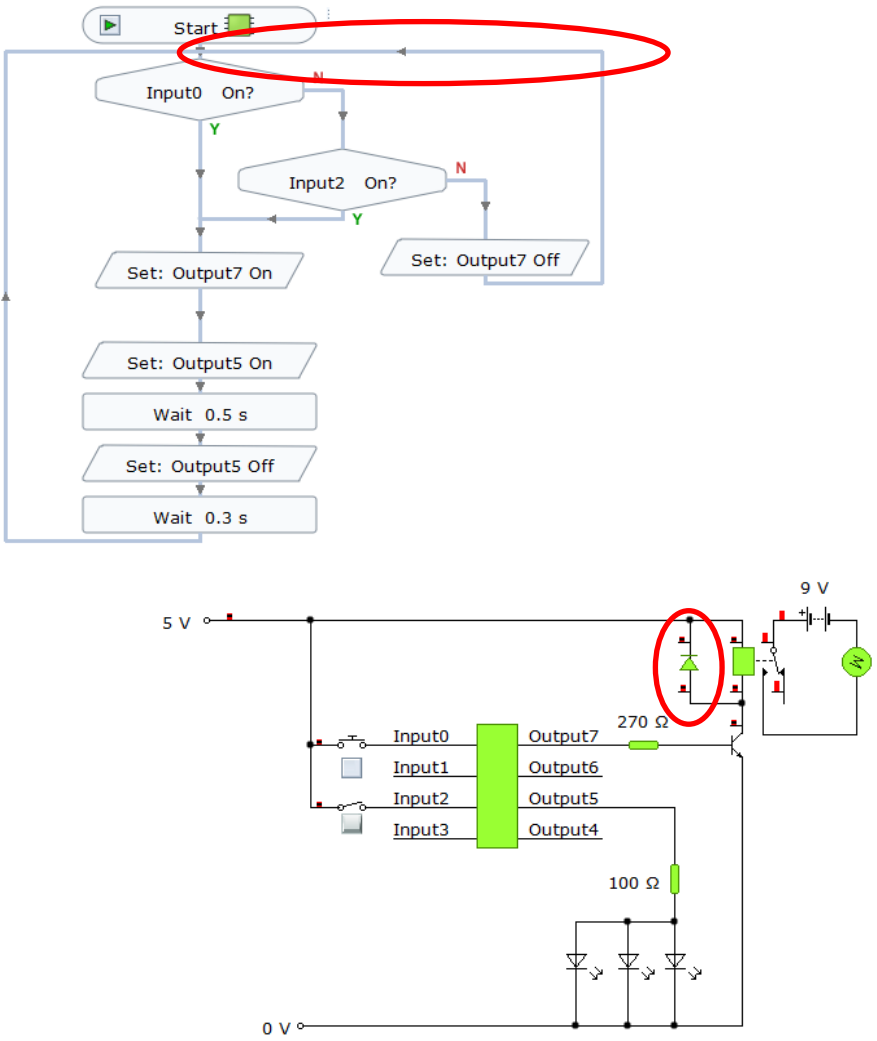
Detailed marking instructions

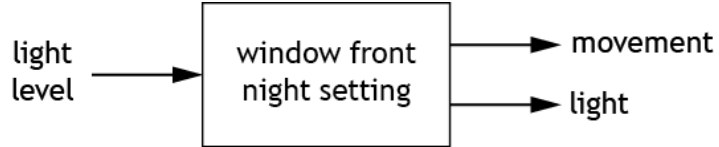
Task			Expected answer(s)	Max mark	Additional guidance
1	a		<p>Diaphragm</p> <p>This actuator would act as a contactless sensor as the train passes, providing a longer lifespan for the sensor.</p> <p>Or</p> <p>Solenoid</p> <p>This actuator can be combined with a microswitch which senses model trains passing.</p> <p>Or</p> <p>Roller trip</p> <p>This actuator will detect trains in one direction of travel.</p>	2	<ul style="list-style-type: none"> • Appropriate actuator selected: Any electrical, mechanical or pneumatic actuator. (1 mark) • An appropriate justification for selected actuator in context. (1 mark) <p>Do not accept a manual actuator.</p> <p>Apply FTE for justification.</p>

Task	Expected answer(s)	Max mark	Additional guidance
1 b		5	<ul style="list-style-type: none"> • Double-acting cylinder to 5/2 valve both pipes (with direction of outstroke indicated correctly if required). (1 mark) • 2 x uni-directional restrictor used to slow instroke & outstroke of cylinder. (1 mark) • 2 x 3/2 valve to cause outstroke and instroke piped to 5/2 valve. (1 mark) • Push button for outstroking and selected actuator, from task 1a, for instroking. (1 mark) • Reservoir after instroking 3/2 valve (with optional uni-directional restrictor). (1 mark) <p>Block diagram, circuit diagram (or a hybrid) or constructed/simulated.</p> <p>Components identified or implied by name or use of components (symbols).</p> <p>Connections between components and valves must be shown. Ignore line types. Port to port piping is not required.</p> <p>Ignore orientation of uni-directional restrictor symbols.</p> <p>Allow FTE for selected actuator (if no response for task 1a, accept any from given table).</p>

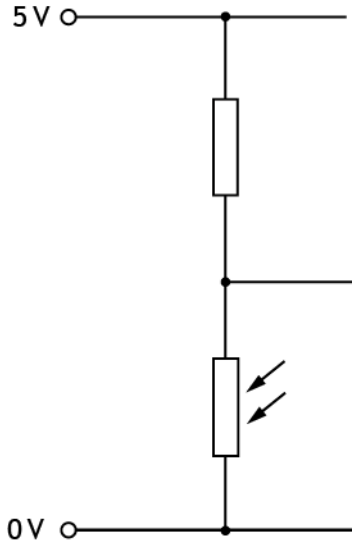
Task	Expected answer(s)	Max mark	Additional guidance
2 a	 <p>The flowchart starts with a 'Start' terminal, leading to a decision diamond 'Input0 On?'. If 'Y' (Yes), it proceeds to 'Set: Output7 On', then 'Set: Output5 On', followed by a 'Wait 0.5 s' block, then 'Set: Output5 Off', and finally a 'Wait 0.3 s' block before looping back to the 'Input0 On?' decision. If 'N' (No), it proceeds to a second decision diamond 'Input2 On?'. If 'Y', it also proceeds to 'Set: Output7 On'. If 'N', it proceeds to 'Set: Output7 Off' before looping back to the 'Input0 On?' decision.</p> <p>The electronic circuit diagram shows a microcontroller with pins Input0, Input1, Input2, Input3, Output7, Output6, Output5, and Output4. Input0, Input1, and Input2 are connected to push-button switches. Input3 is connected to a potentiometer. Output7 is connected to a 270 Ω resistor and a green LED. Output6 is connected to a 270 Ω resistor and a green LED. Output5 is connected to a 100 Ω resistor and a green LED. Output4 is connected to a 100 Ω resistor and a green LED. A 5 V supply is connected to the positive terminals of the switches and the potentiometer. A 0 V supply is connected to the common terminals of the switches and the potentiometer. A 9 V battery is connected to the positive terminal of the potentiometer, and a green LED is connected between the potentiometer's wiper and ground.</p>	5	<p>Flowchart</p> <ul style="list-style-type: none"> • All stages with correct symbols (to the software) and connections. (1 mark) • All correct pin numbers, pin states, decisions and time delays (to the software). (1 mark) <p>Electronic circuit</p> <ul style="list-style-type: none"> • All correct components selected. (1 mark) • Correct wiring, microcontroller pin connections, component orientations and values. (1 mark) <p>Integration</p> <ul style="list-style-type: none"> • Of flowchart and electronic circuit. (1 mark) <p>Note: Allow use of alternative-sized microcontrollers.</p>

Task			Expected answer(s)	Max mark	Additional guidance
2	b		<pre> main: label0: if Input0 = 1 then label1 label2: if Input2 = 1 then label1 low 7 goto label2 label1: high 7 high 5 pause 500 low 5 pause 300 goto label0 goto label1 </pre>	1	<ul style="list-style-type: none"> Code to fully match the flowchart, including pin numbers, in task 2(a). (1 mark) <p>Accept manually written/automatically generated.</p> <p>Any high-level language acceptable.</p>

Task	Expected answer(s)	Max mark	Additional guidance
2 d		2	<ul style="list-style-type: none"> • Candidate's planned amendment 1 carried out: correction of protective diode orientation. (1 mark) • Candidate's planned amendment 2 carried out: Connection from output 7 off returning to start. (1 mark)

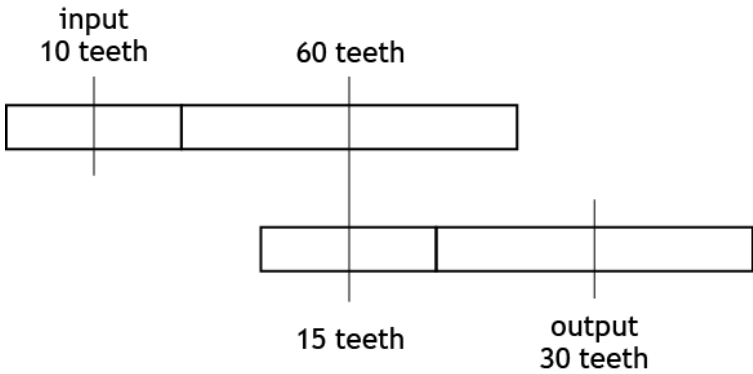
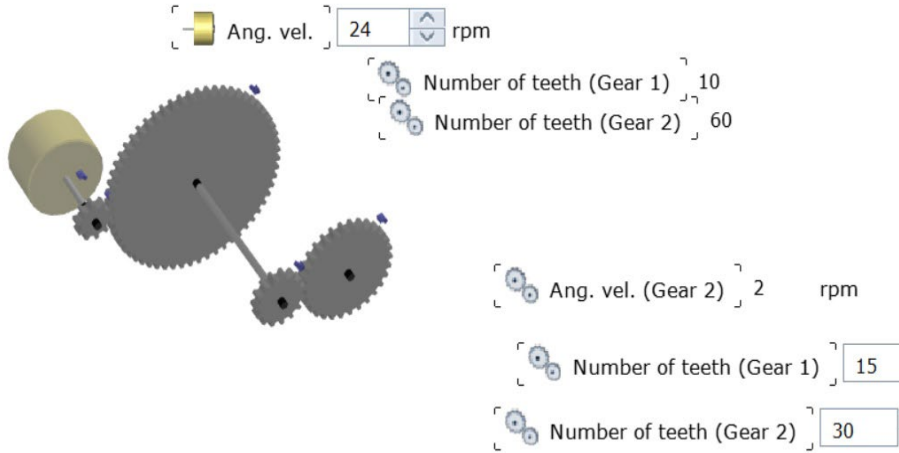
Task			Expected answer(s)	Max mark	Additional guidance
3	a	i	 <pre> graph LR A[light level] --> B[window front night setting] B --> C[movement] B --> D[light] </pre>	2	<ul style="list-style-type: none"> • Light/dark level input identified (implied). (1 mark) • Light and movement (implied) outputs identified. (1 mark) <p>Accept light/daylight/darkness on its own as input.</p> <p>Do not accept light sensor.</p> <p>Do not accept components/devices.</p> <p>Ignore extra boxes or words.</p>

Task			Expected answer(s)	Max mark	Additional guidance
3	a	ii	<pre> graph LR subgraph SystemBoundary [] direction LR LS[light sensor] --> MC[microcontroller] MC --> D1[driver] MC --> D2[driver] D1 --> M[motor] D2 --> L[lamp] M --> MS1[limit switch] L --> MS2[limit switch] MS1 --> MC MS2 --> MC end LL[light level] --> LS M --> Mov[movement] L --> LightOutput[light] </pre>	6	<ul style="list-style-type: none"> System boundary around sub-systems only and boxes around each sub-system. (1 mark) Motor in output position. (1 mark) Lamp in output position. (1 mark) One driver per output device individually connected to microcontroller. (1 mark) 2 (limit) switches connected individually to the microcontroller. (1 mark) Feedback loop(s) from after motor via (limit) switch(es) into microcontroller with both arrowheads. (1 mark) <p>Accept 'motorised blind'.</p> <p>Do not accept 'light', 'bulb' or 'LED' instead of 'lamp'.</p> <p>Do not accept an action (eg 'lamp on').</p> <p>Ignore extra sub-systems. If no arrows shown between sub-systems, assume left to right.</p>

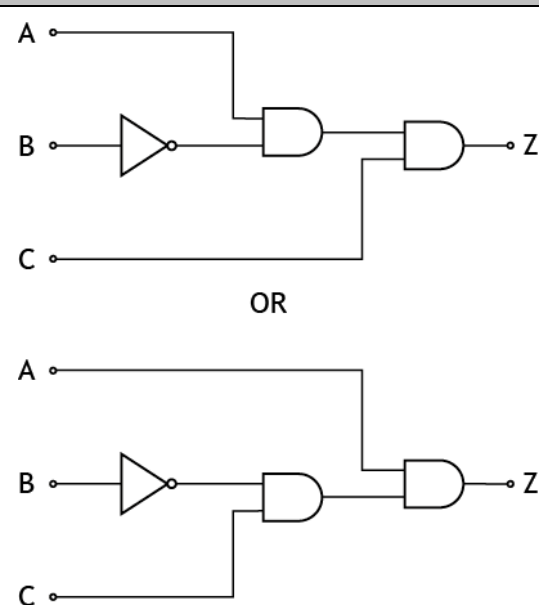
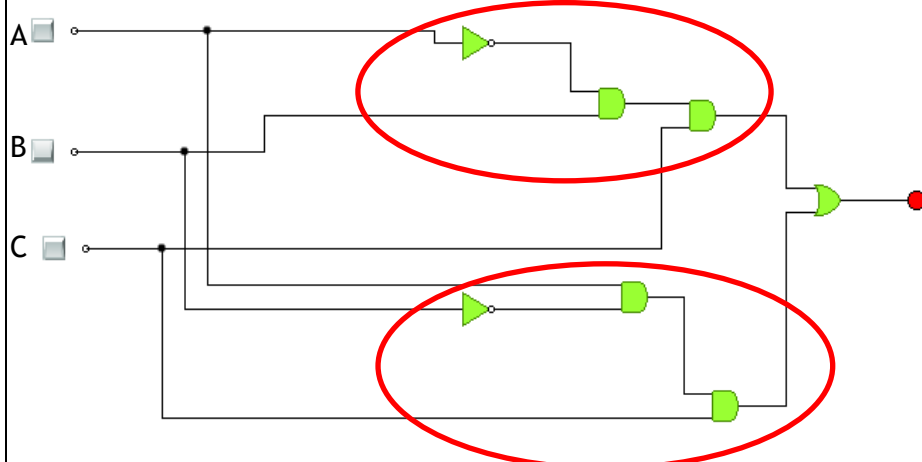
Task			Expected answer(s)	Max mark	Additional guidance
3	b		 <p>The diagram shows a series circuit connected between a 5V supply and a 0V supply. The components in series are a fixed resistor (represented by a rectangle) and an LDR sensor (represented by a rectangle with two arrows pointing towards it). A terminal is provided between the fixed resistor and the LDR sensor.</p>	3	<ul style="list-style-type: none"> • Correct symbol for LDR. (1 mark) • Correct symbol for fixed/variable resistor. (1 mark) • Correct position of components connected to create a dark sensor. (1 mark) <p>Values of components are not required.</p> <p>Do not accept simulation/construction evidence.</p> <p>Ignore additional circuitry.</p>

Task			Expected answer(s)	Max mark	Additional guidance						
3	c		<table><tr><th>Planned test</th><th>Expected result</th></tr><tr><td>Test 1 Reduce the light level.</td><td>V_{out} will increase.</td></tr><tr><td>Test 2 Increase the light level.</td><td>V_{out} will decrease.</td></tr></table>	Planned test	Expected result	Test 1 Reduce the light level.	V_{out} will increase.	Test 2 Increase the light level.	V_{out} will decrease.	3	<ul style="list-style-type: none">V_{out} increases. (1 mark)Test for rising light level. (1 mark)Expected result from given test in terms of V_{out}. (1 mark) <p>Apply FTE for expected result from Planned test 2.</p> <p>If no planned test 2 given, then no mark can be awarded for its unless expected result statement includes a description of the planned test.</p>
Planned test	Expected result										
Test 1 Reduce the light level.	V_{out} will increase.										
Test 2 Increase the light level.	V_{out} will decrease.										

Task			Expected answer(s)			Max mark	Additional guidance
4	a					3	
		Specification point	Met? Yes/No	Justification			
		i.	Yes	As the gear system is a compound gear train.	<ul style="list-style-type: none">State that specification (i) was met (Y)/ not met (N) and description referring to compound gear train/number of gears/ size of gears. (1 mark)		
		ii.	Yes	The input gear and output gear both turn in same direction.	<ul style="list-style-type: none">State that specification (ii) was met (Y) and refers to direction of rotation/acting as an idler. (1 mark)		
		iii.	No	The speed of the output gear would be increased.	<ul style="list-style-type: none">State that specification (iii) was not met (N) and refers to increase in output speed (from input drive). (1 mark) <p>Mark can be awarded for specification (iii) for calculation-based justification which must compare like for like (eg velocity ratio to velocity ratio, rather than velocity ratio to gear ratio).</p>		

Task			Expected answer(s)	Max mark	Additional guidance
4	b			2	<ul style="list-style-type: none"> Simple/compound gear train/worm & wheel and all gear sizes. (1 mark) Correct speed reduction of at least a factor of 12 but no more than 20 and labelling input or implied (eg through inclusion of motor or calculations or output labelled). (1 mark) <p>Do not accept chain or belt drive.</p> <p>Do not accept simulation/construction evidence.</p>
	c			2	<ul style="list-style-type: none"> Simulated or constructed of mechanism type shown in 4(b), with input identified. (1 mark) All gear sizes shown and matching the design in 4(b) or evidence of velocity ratio (eg graph) that proves teeth numbers. (1 mark)

Task			Expected answer(s)				Max mark	Additional guidance
4	d						2	<ul style="list-style-type: none">Input and output speed/turns from given solution in 4(c). (1 mark)Correct velocity ratio for input and output speeds given in table (expressed as ratio, number or fraction). (1 mark) <p>Units not required.</p> <p>If no sizes/speed indicated in task 4(c) then use values from 4(b) to determine VR.</p> <p>No evidence of VR (through teeth numbers, graph or velocities) or teeth numbers indicated on either 4(b) or 4(c) then award 0 marks.</p> <p>No evidence of simulation/construction in 4(c). (1 mark maximum for velocity ratio, if correct)</p>
			<table><thead><tr><th>Input speed</th><th>Output speed</th><th>Required VR</th><th>Actual Velocity Ratio</th></tr></thead><tbody><tr><td>24 revs min⁻¹ or 24 turns</td><td>2 revs min⁻¹ or 2 turns</td><td>Between 12:1 and 20:1</td><td>12:1</td></tr></tbody></table>	Input speed	Output speed	Required VR		
Input speed	Output speed	Required VR	Actual Velocity Ratio					
24 revs min ⁻¹ or 24 turns	2 revs min ⁻¹ or 2 turns	Between 12:1 and 20:1	12:1					

Task			Expected answer(s)	Max mark	Additional guidance
5	a		 <p>OR</p>	2	<ul style="list-style-type: none"> NOT gate connected to B. (1 mark) AND gate(s) connected to inputs A, B & C and output Z. (1 mark) <p>Accept alternative correct circuit including three input AND gate.</p> <p>Do not accept simulation/construction evidence.</p>
	b			2	<p>Maximum 1 mark if OR gate not included.</p> <ul style="list-style-type: none"> Mark for $\bar{A}.B.C$ (1 mark) Mark for $A.\bar{B}.C$ (1 mark)

Task			Expected answer(s)	Max mark	Additional guidance				
5	c		<table><tr><td>Modification</td><td>Increase the number of inputs to the circuit. OR Remove the lower part of circuit to only allow one combination of A/B/C.</td></tr><tr><td>Justification</td><td>Increase the number of possible combinations for the toy safe code. OR Increases the chance of getting the code incorrect.</td></tr></table>	Modification	Increase the number of inputs to the circuit. OR Remove the lower part of circuit to only allow one combination of A/B/C.	Justification	Increase the number of possible combinations for the toy safe code. OR Increases the chance of getting the code incorrect.	2	<ul style="list-style-type: none">• Appropriate suggested modification to the logic circuit. (1 mark)• Appropriate justification of suggested modification to the logic circuit. (1 mark) <p>Do not accept ‘to make it harder to solve’ on its own as justification.</p> <p>Do not accept ‘replace OR gate with AND gate’. (input combination impossible)</p> <p>The modification must be to the logic circuit rather than alternative solutions.</p> <p>Apply FTE for justification.</p>
Modification	Increase the number of inputs to the circuit. OR Remove the lower part of circuit to only allow one combination of A/B/C.								
Justification	Increase the number of possible combinations for the toy safe code. OR Increases the chance of getting the code incorrect.								

[END OF MARKING INSTRUCTIONS]