

1(a)	A
1(b)(i)	(000)11000
1(b)(ii)	(0)1100101
1(b)(iii)	19
1(b)(iv)	34
1(c)(i)	0101 0001
1(c)(ii)	1110 0011
1(c)(iii)	82
1(d)	One mark for correct method of working, for example flip and add 1 One mark for correct answer 11111011
1(e)(i)	A
1(e)(ii)	Any three from: • Microprocessor compares the value from the sensor to a stored value • If the values do not match, the microprocessor sends a signal to increase or decrease the temperature • If the values match, no action is taken
1(f)	Any two from: • It has a single/limited function • It is difficult to change its function // cannot be reprogrammed • It has dedicated hardware • It has a microprocessor

6(a)	Any one from: Examples: • Microprocessor • Actuator • Storage/memory
6(b)	Any one from: Examples: • Humidity • Light • Level • Infrared
6(c)(i)	Any three from: • A microprocessor is used. • Microprocessor received data from the sensor. • Microprocessor compares data against preset data of 40. • If the data is greater than 40 the microprocessor sends a signal to trigger the alert.
6(c)(ii)	Any three from: • Data is sent one bit at a time. • ... down a single wire. • Data can only be sent in one direction.
6(d)	Any two from: Examples: • Employees don't need to carry out a mundane/repetitive task. • Employees don't need to work overnight. • Employees don't need to work outside in adverse weather conditions. • Creates maintenance jobs for system
6(e)	Any one from: Examples: • May de-skill the employees • May replace employees and take their job
6(f)(i)	Artificial intelligence // AI
6(f)(ii)	Any three from: Examples: • It can adapt its own processes/data. • It could analyse the data for trends/patterns. • ... and predict future weather patterns based on the patterns. • Feedback is given on weather predictions. • ... changes future predictions based on this feedback. • It could learn what weather occurs at certain times of year. • ... and use this to predict what the weather would be like at the same time of year. • ... and adapt its rules/processes for weather predictions.

5(a)	(A system) that can perform actions without human intervention
5(b)	- It receives data from the sensor - It analyses the data // It checks if the data is within/out of a range // - It sends signals to trigger actions based on the data
5(c)	Any two from: For example: - It stops the farmer having to handle heavy equipment - It frees the farmer up to do other jobs - It doesn't need to take breaks // Can work 24/7 - It can perform boring repetitive tasks - Can save money on labour costs - May be more accurate at ploughing/planting - May be more efficient than the farmer at ploughing
5(d)	Any four from: For example: - It could make use of machine learning - It could gather data from ploughing ... and use this data to adapt its own process ... so that it will make fewer mistakes ... such as the dimensions of the field ... such as the landscape of the field ... such as where obstacles are in the field ... to create a map of the field ... to develop the most efficient route to take ... so, it knows what to avoid in future

6(a)	Any one from: - It has electrical components // by example - It is programmable
6(b)(i)	Any five from: - Sensor continuously sends the digitised value / reading / distance to the microprocessor - Microprocessor compares the data / signal to the stored data of a person and distance of 3m - If the data / signal is less than (or equal to) a person and within 3m ...a signal is sent to actuator to make the tractor stop / apply the brakes - If the data/signal is greater than 3m no action is taken - If stopped and data/signal is not a person and/or more than 3m a signal is sent to actuator to make the tractor start - The whole process repeats until turned off

6(b)(ii)	One mark for sensor and One mark for matching use: e.g. • Accelerometer ... • ...to adjust for uneven ground // to detect if the tractor crashes • Proximity ... • ...to detect if near the end of the field // to detect other obstacles • Light ... • ... to identify when to turn the headlights on
6(c)	Any three from: e.g. • Set-up cost may be high • Maintenance cost may be high • ... needs skilled workers/expert to fix • Farmer may need reskilling in how to use it ... • ... which could be costly • Leads to deskilling of farmers/workers • Farmer may need fewer employees • ... leading to unemployment • Can malfunction • ... and not recognise a person and fails to stop • Changing function can be expensive
6(d)	Any three from • Knowledge base • Rule base • Inference engine • Interface

6(e)(i)	Any three from: • The same data is transmitted back (from computer to tractor) • Tractor compares both sets of data • ... if they are identical there is no error // reverse • Tractor sends confirmation of accuracy if the same // Tractor resends the data if they are different // Tractor transmits error if they are different																																																																																	
6(e)(ii)	One mark for two correct Two marks for five correct Three marks for all eight correct <table><tr><td></td><td>parity bit</td><td>bit 7</td><td>bit 6</td><td>bit 5</td><td>bit 4</td><td>bit 3</td><td>bit 2</td><td>bit 1</td></tr><tr><td>byte 1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr><tr><td>byte 2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>byte 3</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>byte 4</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>byte 5</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>byte 6</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>byte 7</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>parity byte</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr></table>		parity bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	byte 1	1	1	0	0	1	1	1	0	byte 2	1	0	0	0	0	1	1	0	byte 3	0	1	0	0	0	0	0	0	byte 4	0	1	0	0	1	1	1	1	byte 5	1	0	0	0	0	0	0	0	byte 6	0	1	1	1	1	1	1	1	byte 7	1	1	0	0	1	1	0	1	parity byte	1	0	0	0	1	0	1	0
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11(a)	– Amount of liquid/gas/steam flowing/moving through an environment
11(b)	Two from (for benefit and matching description) e.g.: – Increases safety – ...meaning that workers do not need to go into dangerous areas to collect data/make checks/do dangerous tasks – Can increase jobs/skills – ...as employees are needed to learn/maintain the equipment – No need to do repetitive tasks – ... so, they can use their time on other/more skilled tasks
11(c)	Two from (for drawback and matching description) e.g.: – High set-up/installation costs – ... it would mean the company need to find a lot of money up front to pay for the equipment // employees will need training – Utility/maintenance/repair costs – ... increase in bills such as electricity // skilled employees will be required to maintain the system // equipment will break/need updating – Deskillling of the workforce – ... may mean that workers will no longer have the skills for some of the manufacturing jobs, should the equipment break

5(a)	Any one from: • Level • Pressure • Moisture
5(b)	Any Six from: • Sensor continually sends digitised data to microprocessor • Microprocessor compares data to stored value(s) • If value is outside range / matches microprocessor sends signal to release water to refill water bowl • ... bowl filled by set amount // bowl filled for certain time • Actuator used to release water • Whole process repeats until turned off/stopped