6 A self-driving tractor sows seeds and harvests crops for a farmer. The self-driving tractor moves automatically through the field, turning at each end and stopping when it has finished.

(a) One reason the self-driving tractor is a robot is because it has a mechanical structure that includes wheels, an engine, and a framework.

Give **one** other reason why the self-driving tractor is an example of a robot.

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..... [1]

(b) If a person is detected within 3 metres whilst the tractor is moving, the self-driving tractor must stop.

(i) Explain how an infra-red sensor, microprocessor and actuator can be used to stop the self-driving tractor if a person is detected within 3 metres.

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..... [5]

(ii) Identify **one** other sensor that the self-driving tractor might use and how it will use the sensor.

Sensor .....

Use .....

.....
[2]

(c) Explain the drawbacks of a farmer using a self-driving tractor to sow seeds and harvest crops.

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..... [3]

(d) The self-driving tractor has an in-built expert system that the farmer can use to solve any errors with the tractor.

Identify **three** components of an expert system.

1 .....

2 .....

3 .....
[3]

(e) At the end of each day the self-driving tractor transmits the data it has collected to the farmer's computer in their house.

The transmission uses an echo check.

(i) Describe the role of the self-driving tractor and the farmer's computer in the echo check.

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..... [3]

(ii) Another method of error checking is a parity block check.

The table shows 7 bytes that are transmitted using odd parity. The parity bit has been completed for each byte.

Complete the parity byte for the data.

	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								

[3]