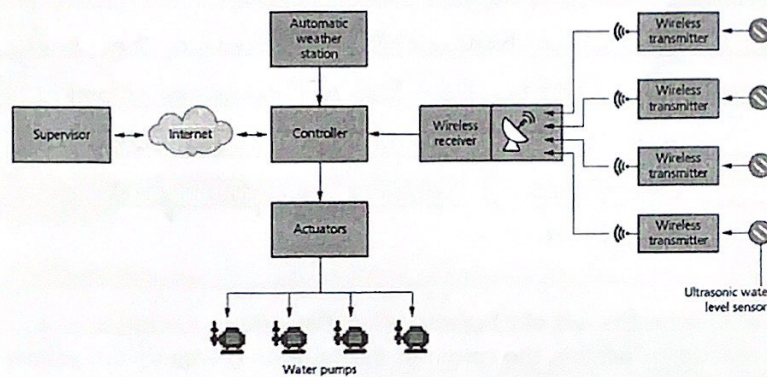**IGCSE Computer Science.**

60

/60

100 %

Name: _____

Chapter 6 Test – New and Emerging Technology

1.

The following diagram shows how sensors, actuators and microprocessors can be used to automatically control the irrigation system.

a Using the diagram, explain how sensors, actuators and a microprocessor (controller) are used to monitor and control this irrigation system.

5/[5]

(ultrasonic water level)   (controller)

Sensors, receive data and send it to microprocessor via wireless transmitter and receiver. Microprocessor converts data from analogue to digital, and compares the data with stored value (from weather station). If higher than stored value, it will tell actuators to reduce water level. If lower, it will tell actuators to increase water level. The process is continuous.

**b** Describe the advantages and disadvantages of using this automated irrigation system.

⁵/[5]

Advantages : Continuous work (24/7), is precise and can exactly keep water level at the optimum, and is safer. It eliminates risk of humans getting sunburnt or injured while in the fields. Creates jobs in maintaining the system

Disadvantages : High initial cost (expensive to buy the system), high running cost, and cost for maintaining and debugging the code, replaces people's jobs on the land.

2.

A laboratory experiment involves the use of a burette 'A' adding acid to a solution in a conical flask 'B'. As the reaction proceeds, the colour of the solution changes from yellow to red. The colour change is picked up by a sensor called a colorimeter. The amount of acid to be added is measured using two level detectors; the opening and closing of the burette tap is controlled by an actuator. As soon as the solution in 'B' turns red, the whole process is stopped. A microprocessor controls the whole process, as shown in the diagram.
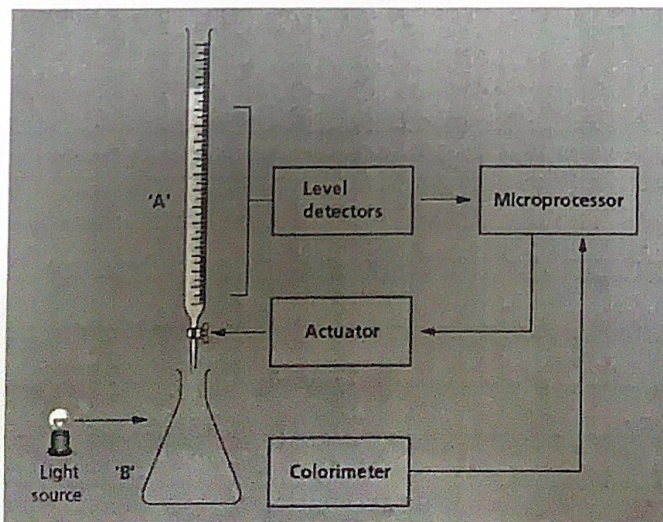
a) Explain how sensors, actuators and a microprocessor are used to control the experiment to ensure the final product (red colour) is always produced.

Sensor (colorimeter) collects data about the colour of the solution continuously, and sends the data to the microprocessor, which converts data from analogue to digital. It compares the data to a stored value for the right colour of red. If not equal to that colour, it tells actuator to open tap. As soon as equal, actuator stop and turn off tap. terminary the espirat. level detector detect the volume at end and calculate volume used up by doing initial - final volume. Process is continuous.

4 [4]

b) Describe the advantages and disadvantages of using an automated system in this experiment.

Advantages: Highly precise, and accurate, eliminates human error - Can tell you exactly how much acid is needed to make the colour red. Can work 24/7 INSTANTANEOUS all day everyday, as long as you give it the stock chemicals. Safer as people won't have risk of corroding themselves with acid.

Disadvantge: Expensive to set up and maintain (high initial and running cost), replaces people's jobs, requires continous supply of chemical, requires lots of energy and power

4 [4]

3

a) Name suitable sensors for each of the following automated systems.

i) Manufacture of a new vaccine which requires the mixing of four liquids in the ratio 1|2|3|4 as a single batch. The four liquids must be totally mixed and the temperature must be maintained at 35 °C (± 1 °C) which is a critical temperature.

Temperature sensor, pH sensor, colorimeter

ii) A lighting display has been set up in one room of an art gallery. A random sequence of different coloured lights is under microprocessor control. The display in the room only switches on when visitors walk into the room; at the same time, the room lights are also dimmed to give the most dramatic effect of the light display.

Infrared Infra-red sensor, proximity sensor, light intensity sensor

iii) A train uses automatic twin-doors. Both doors open automatically when the train stops. Both doors close again when no one is still boarding or leaving the train. The doors have a safety mechanism so that a passenger cannot become trapped between the two closing doors. The train can only move off when every door on the train has been safely closed.

Infra-red sensor, proximity sensor, accelerometer, pressure sensor

6/[6]

b) For each application in part a), give one advantage and one disadvantage of using automated systems [4]

i)

Advantage: Highly accurate and precise
Disadvantage: High initial cost (expensive to set up)

ii)
A: Mfg Continues - works 24/7 whenever someone steps into room
D: Replaces High running cost and maintenance cost (expensive to maintain)

iii)
A: Safer - ensures no one trapped between doors
D: Replaces people's jobs (people checking if everyone's boarded on the platform.

4

The eight statements on the left-hand side of the table are either true or false. Tick (✓) the appropriate box to indicate which statements are true and which statements are false.

Statement	True	False
Automated systems lead to less consistent results or less consistent products.		✓
Automated systems are more expensive to set up than traditional manual systems.	✓	
Automated systems would be quickly overwhelmed by the amount of data presented to them.		✓
Automated systems are inherently less safe than manual systems.		✓
Automated systems generally require enhanced maintenance when compared to manual systems.	✓	
Automated systems allow processes to run at optimum conditions at all times.	✓	
Software failures, due to unforeseen conditions, are unlikely to impact on an automated system.		✓
Automated systems will react more quickly to unusual process conditions.	✓	~~✓~~

Unusual

7/[8]

5.

a) Describe the three characteristics that must be shown by a device for it to be regarded as a robot. [3]

Mechanical structure or framework

Programmable

Have electrical computer - servos, microprocessor, actuators

3

b) Explain the difference between dependent and independent robots. [2]

Normly vey specific to one kind of task

Dependent robots are ones which depend on a human input to function — humans give it rules to follow. Independent robots are ones which learn by themselves, and by experience, such as AZ, and can do all sorts of tasks.

c) Describe briefly two examples of software robots. [2]

Expert systems (Wireless troubleshooting) 2
Artificial intelligence (and machine learning)
↳ Such as Siri or Cortana, voice assistant

6

Use the following words to complete the paragraph that follows. [4]

actuators	end-effectors	microprocessor	repetitive
adaptive	environment	physical	sensors
controller	intelligence	programs	system

Robots can collect data from their surroundings by using ‹ *sensors* ›. The data is then sent to a ‹ *microprocessor* › to allow the robot to build up an image of its ‹ *environment* ›. Robots can do various tasks by using different ‹ *actuators* ›. The 'brain' of the robot is often called a ‹ *controller* ›, which contains ‹ *programs* › to allow it carry out various tasks automatically. Many robots are not (artificially) intelligent, since they only do ‹ *repetitive* › tasks rather than requiring ‹ *adaptive* › human characteristics. [4]

7

Autonomous robots are used in space exploration and in undersea exploration. These robots have to either work in the near vacuum of space or the very high pressures under the oceans. They need to be equipped with many sensors and cameras to carry out their remote tasks.

a) The undersea robots are being used to investigate shipwrecks. Describe how the sensors and cameras could be used to photograph the shipwrecks. Also describe the role of the microprocessor and actuators in taking photographs and any samples needed from the shipwreck for further investigation. [3]

Sensors (infra-red) allow it to map out its environt. Data from sensor sent to microprocessor, which converts data from analogue to digital. Cameras give picture, which can be combined with info from IR sensor, to map out a 3D model of the shipwreck. *(distances)* After microprocessor tells actuator to collect samples of in specific parts. Continues process.

b) A space exploration robot has been sent on a mission to Mars. The robot needs to move around the surface of the planet safely, taking photographs and taking soil/rock samples for later analysis.

i) Describe how sensors, actuators and a microprocessor can be used to take samples from the planet's surface. [2]

Sensors (infra-red) collect data, send it to microprocessor, which converts data to from analogue to digital. Microprocessor tells actuators to move it across landscape, and when it has photo detected something special that it wants to investigate, it can direct the actuator to collect samples of it. Continuous process.

ii) Describe three uses of the cameras on this autonomous robot. [3]

for themselves and human researchers

Take photos of environment, Help robot identify which areas are safe to travel on, and which areas aren't safe. Help robot identify which parts are interesting to explore, which rocks are unique and can be taken as samples, prevent the robot from bumping into rocks in front of it

c) Describe the advantages of using autonomous robots in both undersea and outer space exploration. [3]

Continuous work, 24/7 (all day everyday). Safer for robots to go and explore, than for humans to (unknown environment is dangerous). Precise and accurate, so can collect more information than humans could in a shorter time. Able to withstand vacuum [Space + Undersea] and high pressures (which humans can't).

d) Give two other examples of where autonomous robots could be used. [2]

Car manufacturing
House cleaning (vacuum), Roomba

End of test