

Name _____

Class _____

Date _____

By the end of this worksheet I can...

- ☐ complete universal system and sub-system diagrams
- ☐ identify open and closed loop control
- ☐ explain the purpose of a system boundary and an output driver
- ☐ describe the operation of a closed loop system using the correct terms

I DO**Key ideas** Read this before the questions

- **Universal system diagram:** input → process → output. Use the general words "input", "process" and "output" where asked.
- **Open loop:** no feedback, so the output isn't checked. **Closed loop:** a sensor measures the actual output and feeds it back.
- **Sub-system diagram:** the blocks inside the system (control, driver, output, sensor), with a dashed **system boundary** round them.
- An **output driver** boosts the small signal from the control unit so it can power the output device.

Remember

Describe closed loop control in this order: SET (the user sets the value) → ACTION (the output switches on) → FEEDBACK (the sensor measures the actual value) → COMPARE (control compares actual with set) → ADJUST (the output switches on or off).

A heating system keeps a room at a set temperature.

Example Describe how the closed loop system controls the temperature.

Worked answer set out every step like this

The user sets the required temperature.

The control unit switches on the heater through the output driver.

The temperature sensor measures the actual temperature and feeds it back to the control unit.

The control unit compares the actual temperature with the set temperature.

When the actual temperature reaches the set temperature, the heater is switched off; when it falls below, it is switched on again.

YOU DO

SQA past paper questions Answer on the question or on the lines below it.

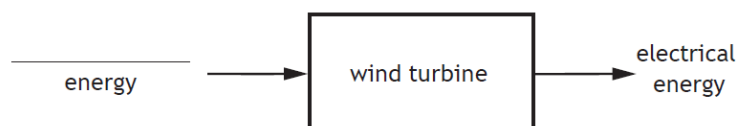
SQA 2024, question 5(b) and (c)

1 Complete the diagram by adding the missing input energy, then state the type of control that uses feedback.

An incomplete diagram showing the **energy** transformation in a wind turbine is shown below.

(b) Complete the diagram by adding the missing input **energy**.

1



The wind turbine uses feedback in its operation.

(c) State the type of control that uses feedback.

1

SQA 2024, question 11

2 Complete the sub-system diagram for the dishwasher with reference to the specification.

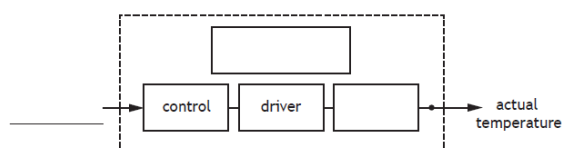
11. A dishwasher in a restaurant kitchen is shown.



Part of the specification for the dishwasher is given below:

- A user selects a set temperature.
- A sensor detects the actual water temperature and sends a signal to the control.
- The control compares the actual water temperature with the set temperature.
- If the actual water temperature is lower than the set temperature a heating element will switch on.

An incomplete sub-system diagram for the dishwasher is shown below.



(a) Complete the sub-system diagram with reference to the specification.

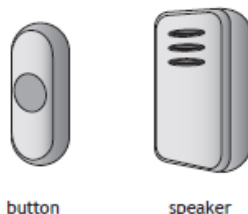
4

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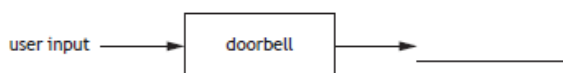
SQA 2023, question 1

3 Complete the system diagram by adding the missing output, then state the type of control that has no feedback.

1. The parts of a doorbell, consisting of a button and speaker, are shown.



(a) Complete the system diagram shown below for the doorbell by adding the missing output.



The doorbell operates without the use of feedback.

(b) State the type of control that uses feedback.

1

1

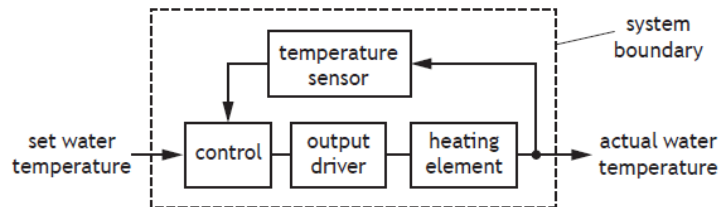
SQA 2023, question 12

4 A sub-system diagram for controlling the water temperature in a washing machine is shown.

12. A washing machine is shown.



A sub-system diagram showing the control of the water temperature in the washing machine is shown below.



(a) Describe the reason for including a system boundary in a sub-system diagram. 1

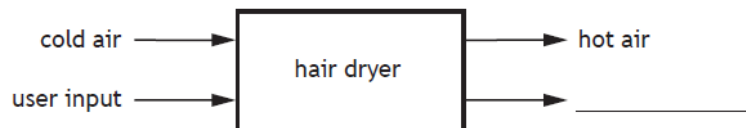
a) Describe the reason for including a system boundary in a sub-system diagram. (1 mark)

b) Describe, with reference to the sub-system diagram, the control of the water temperature. (3 marks)

SQA 2022, question 2

5 Complete the system diagram by adding the missing output, then state the type of control that has no feedback.

2. An incomplete system diagram for a hair dryer is shown.



(a) Complete the system diagram above by adding the missing output.

1

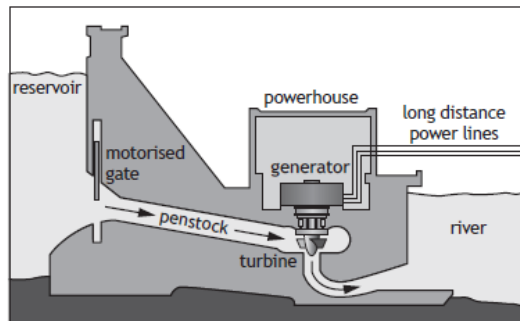
(b) State the type of control that has no feedback.

1

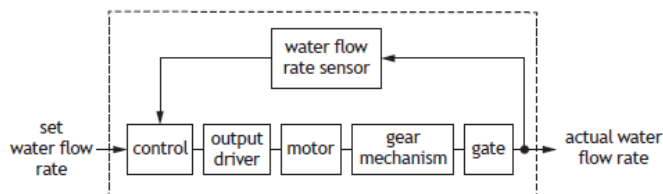
SQA 2022, question 14

6 Describe, with reference to the sub-system diagram, the operation of the system.

14. Hydropower is used to produce electricity from stored water in a reservoir.
A diagram of a hydropower station is shown.



A steady flow rate of water must move through the penstock to rotate the turbine.
The water flow rate is adjusted by a motorised gate which can move up or down.
A sub-system diagram for the control of the motorised gate is shown.



- (a) Describe (with reference to the sub-system diagram) the operation of the system.

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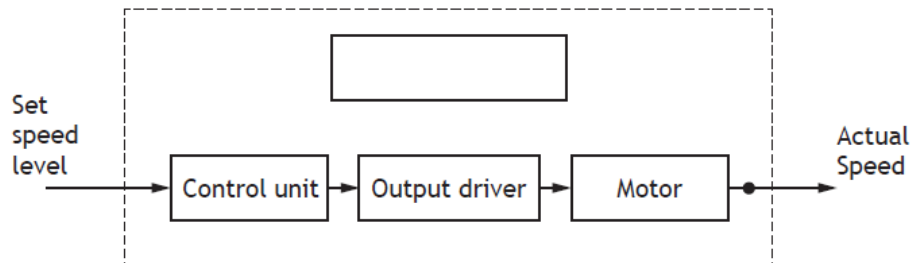
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SQA 2014, question 1

7 Complete the sub-system diagram for the closed loop motor speed control system.

1. A closed loop system is used to control the speed of a motor.
Complete the sub-system diagram shown below.

2



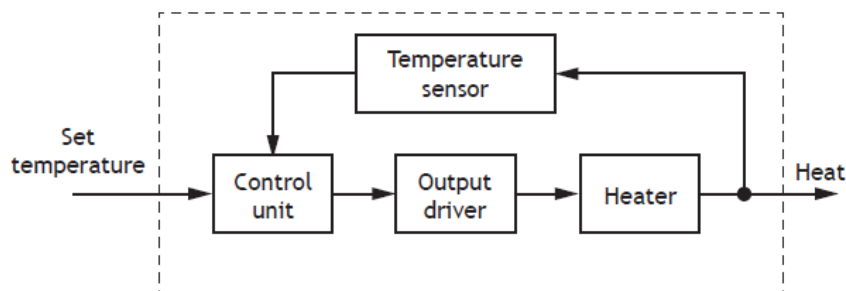
SQA 2015, question 3

8 State the name of this type of diagram, and the function of the output driver.

3. A diagram for a heating system is shown below.

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- (a) State the name of this type of diagram.

1

- (b) State the function of the output driver.

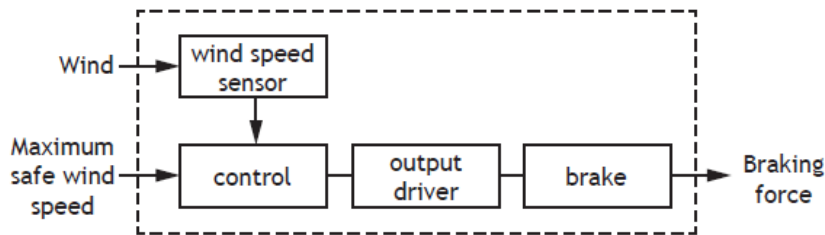
1

SQA 2015, question 10(b)

9 Describe, using appropriate terminology, the operation of the wind turbine braking system.

10. (continued)

A wind turbine can only be used when the wind speed is below a maximum safe level. A diagram for part of the braking system is shown below.



(b) Describe, using appropriate terminology, the operation of the wind turbine braking system.

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3

Check and reflect

Mark your answers with the answer sheet. Which “I can” statement above still needs work? Look back at the notes for that topic on the site.