Teaching suggestions

Important note: The student is to achieve the module/section purpose and section objectives essentially by skill practice.

(a) Control valve characteristics (inherent and installed), sizing, rangeability and turndown.

(b) Process gain characteristics: linear, non-linear, load dependent.

(c) Control valve selection.

(d) Loop installation diagrams and circuit connections (simple feedback loops, ratio and cascade loops).

(e) Skill practice: install/connect and test control loop instrumentation.

(f) Tuning methods: systematic trial, ultimate cycling, step response or computer methods. Control criteria: QAD and minimum disturbance.

(g) Skill practice: tune single/multi-variable control loop analogue and/or microprocessor based controllers.

TAFE NSW

Module Resource Manual

NI208

Process Control Systems

Student Workbook

First Edition

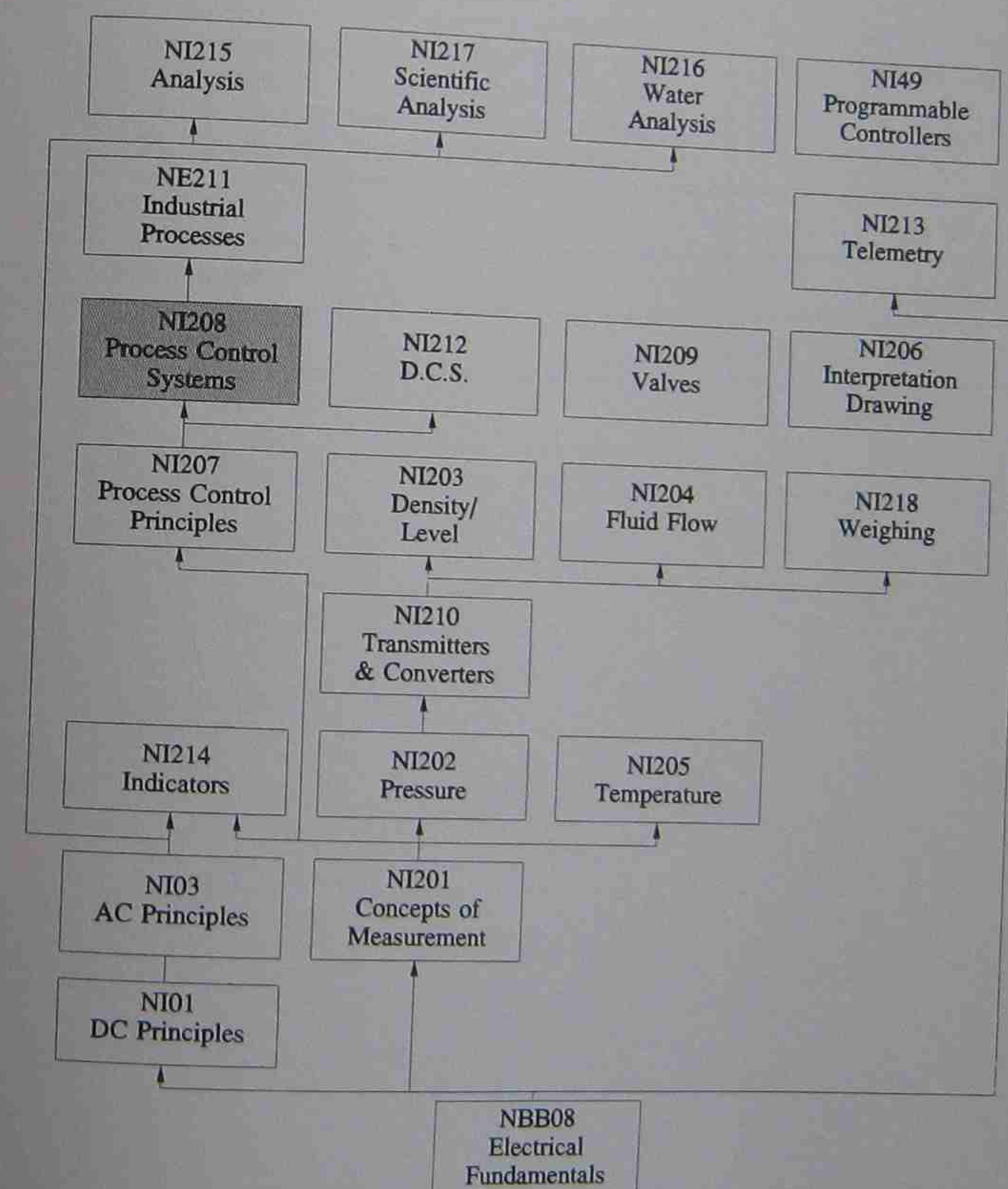
Engineering Services
Training Division

CONTENTS

About this module

This module is part of the Instrument stream in the TAFE Metal and Engineering National Curriculum Project and is the second of three process control modules. The prerequisite for this module is NI207 Process Control Principles and NI205 Temperature and either NI203 Density/Level or NI204 Fluid Flow.

The diagram below shows the place of this module NI208 in the Instrument stream. This module provides students with a working knowledge and understanding of process control systems and instrumentation. In particular, it provides knowledge and skills for control loop tuning procedures and the ability to connect and check a range of typical control loops.



The prerequisite modules introduced process measurement and control principles. This module will use this foundation to further the students skills and understanding of process control systems.

Module organiser

Section	*Activity*	*Learning outcomes covered*	*Suggested time*
1	Process controllers Skill practice 1: Controller functions/options Skill practice 2: Controller modules and alignment Skill practice 3: Reset wind-up and derivative bump	1, 2, 3	8 hrs
TEST 1 Theory test 1			1 hr
2	Control strategies and controller configurations Skill practice 4: Microprocessor configurations Skill practice 5: Process operation	5,6	11 hrs
3	Tuning and installation of control loops Skill practice 6: Loop connection and testing Skill practice 7: Single variable loop testing Skill practice 8: Multi-variable loop tuning	4,5, 7,8	13 hrs 20 mins
TEST 2 Theory test 2			1 hr 20 mins
TEST 3 Practical test 1			1 hr 20 mins
		TOTAL	36 hrs

Notes

MODULE SECTIONS

Section 1: Process controllers

SUGGESTED DURATION	PURPOSE
8 hours	This section deals with the application and operation of common controller types, their functions, modes and options.
This section covers learning outcomes 1, 2 and 3 of the National Module Descriptor.	

Objectives

At the end of this section you should be able to:

- ☐ describe common methods of generating PID functions
- ☐ explain the application of the P, I and D modes
- ☐ explain the application of typical controller functions and options (e.g. local, remote and tracking set points)
- ☐ check and adjust controller modes and functions
- ☐ demonstrate reset wind-up and derivative bump.

Notes

Skill practice 1: Controller functions and options

Suggested duration
2½ hours

Task
To check and adjust typical controller functions and options such as action, local-remote set point, set point tracking, and alarms.

Note: A microprocessor based PID controller is most suited to this skill practice.

Equipment
- Suitable PID controller and input signal
- Source/calibrator to provide 4-20 mA or 1-5 V
- Instruction manual

Procedure

Part A - Equipment

1. Refer to the connection schematic and determine all the equipment and parts required to connect this controller and list below.

   List of equipment

   ____

   ____

   ____

   ____

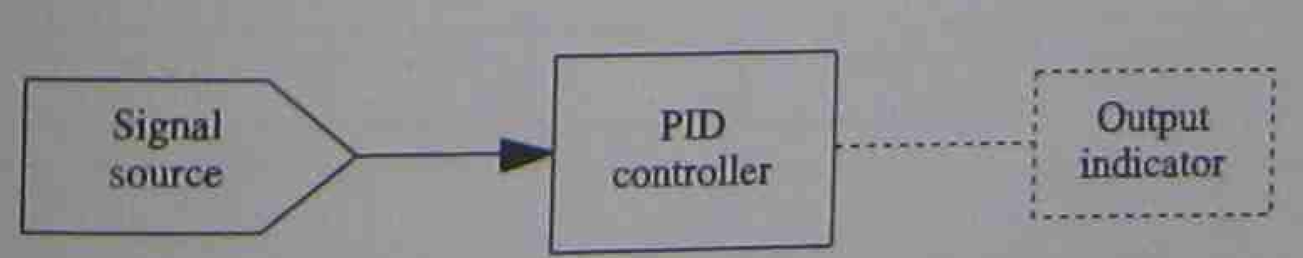
   ____

   ____

2. Obtain the necessary equipment from the store.

3. Refer to the connection schematic and instruction manual, sketch the connection diagram, showing terminals/connection numbers and polarities.

   Connection schematic



Connection diagram

4. Connect the equipment and have the teacher check the connection.

Teacher check

1st try	*2nd try*

Part B - Performance checks

1. (a) Controller action - direct/reverse

(i) • Turn off I and D, and set controller gain to 1.

• With controller on auto, vary the PV and set point and check the control action and complete the tables.

TABLE 1: CHANGE TO PV

Set point	*Δ PV*	*Δ Output*	*Action: direct/reverse*
40%	+10%		
40%	-10%		

TABLE 2: CHANGE TO SET POINT

PV	*Δ Set point*	*Δ Output*	*Action: direct/reverse*
60%	+10%		
60%	-10%		

• From the results above, the controller action is: ____________

• Compare the results from Table 1 and Table 2 and explain the differences.

____

____

____

____

(ii) Change the action of the controller and check the operation of the control action by changing the PV by +10% and -10%. You may need to use an instruction manual.

Have the teacher check your results.

Teacher check

1st try	*2nd try*

• How is the control action changed?

____

____

____

____

(b) Local-remote set point

Preamble: the 'local' set point is adjusted on the controller faceplate by pushbutton or control knob. The remote set point is set by an external signal.

• How is this controller switched to remote set point?

____

____

____

____

• Connect an external set point signal source.

• Switch to remote set point.

- Vary the external set point, and with the controller on automatic, verify the operation of the set point and the controller.

  - set point varies Yes/No ______
  - output varies Yes/No ______
  - controller action is: ______ (direct/reverse)

(c) Set point tracking

(i) • Set the controller to, tracking set point.

- Note the output on auto, ______ %
- Note the set point value, ______ %
- Switch to manual and observe the set point response.
- Vary the process variable and note the set point response.

Have the teacher check operation.

Teacher check

1st try	*2nd try*

- What have you observed?

______
______
______
______
______

(ii) • Set the controller to, non-tracking set point, and repeat the steps as in (i) above.

- What have you observed and how is it different from the tracking set point setting?

______
______
______

(d) Alarms

- Does this controller have high/low alarms?

  ______

- Are the alarms adjustable? How?

  ______
  ______
  ______
  ______

- Test (and adjust the alarm limits).
  - The alarm limits were set to

    ______

  - The alarm limits were adjusted to

    ______

- Return the alarm limits to the original high/low settings.

(e) Other features

(i) Does this controller have any other functions/options (e.g. square root extraction)? List these functions, and state how they are selected/adjusted.

______
______
______
______
______
______

(ii) • Set the controller to apply square root to the PV (input signal), and complete the table.

PV input	Calculated $\sqrt{input}$ %	Indicated PV %
0%		
25%		
49%		
64%		
81%		
4%		
9%		
16%		

- Comment on the results at low valves of input signal (PV).

- State the common application of square root extraction.

Conclusion

Briefly summarise your observations by stating the purpose of the option/functions that you have tested.

- Direct-reverse action

- Local remote set point

- Set point tracking

- High/low alarms

- Other options

Skill practice 2: Control modes and controller alignment

Suggested duration

2½ hours

Task

To check the alignment and the Proportional and Integral control modes of a typical analogue process controller.

Procedure

Part A

1. Refer to the diagram below and determine the equipment required for this task.

   List of equipment

   ____

   ____

   ____

   ____

   ____

   ____

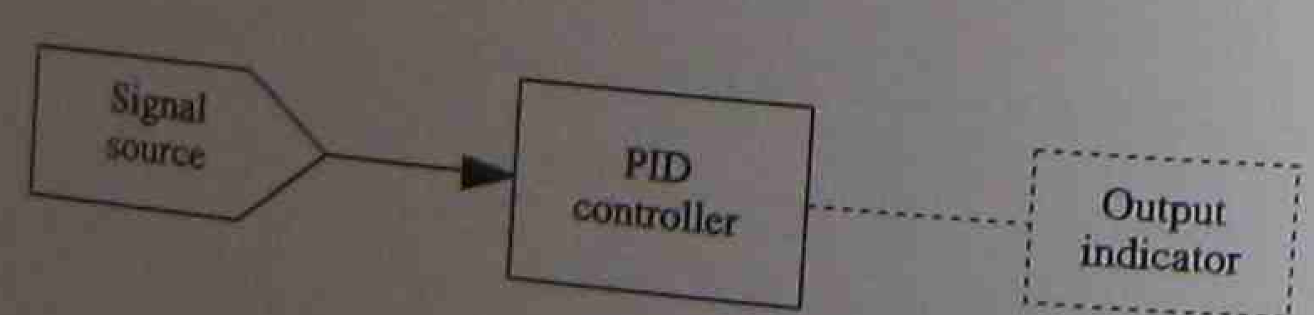
2. Obtain the necessary equipment from the store.

3. Refer to the connection schematic and sketch the connection diagram required for the equipment you have selected.

4. Connect the equipment.

5. Perform the performance checks as detailed in Part B of this skill practice.

Connection schematic



Connection diagram

Part B

1. (a) Alignment check

   (i) Set gain ≈ 0.5, turn I and D off.

   (ii) Adjust the PV to equal the set point, and with PV equal to set point, adjust output signal to 50%.

   (iii) Increase the controller gain (e.g. from 0.5 to 5) as there is no error (deviation), the output signal should not vary. If the controller is out of alignment, the output will vary.

   (iv) If the controller is out of alignment, check the amount of offset that will be caused. Note your results below:

Alignment (correct/incorrect): ____________
% offset: ____________

   (b) Open loop proportional (gain) check

   (i) Vary the gain and PV as necessary to complete the table below.

±ΔPV	*Set gain*	*% change in output*	*Calculated gain*	*Action: direct/reverse*
+10%	x1	+10%		
-10%	x1			
+10%	x2			
-10%	x0.5	-10%		

(ii) Sketch graphs of each check, (i.e. Δ PV , Δ O/P) showing the PV and output changes.

(c) Open loop integral action check

(i) • Set gain = 1, turn off I and D
• set PV = set point
• adjust manual output to 20%, switch to auto.

Note: Now, PV should equal the set point and output signal should be 20%.

(ii) Set Ti = 1 minute.

(iii) Adjust PV by 10%. (-10% for reverse action, or +10% for direct action).

• The output should now change, and ramp up. i.e. 10% step increase due to controller gain, and then 10% per minute increase due to integral action.

(iv) Vary the controller gain and integral time as necessary to complete the table below.

Test	*Set gain*	*Set Ti (mins)*	*Step change to PV*	*in O/P*	*Signal at time (mins)*					
					1	*2*	*3*	*4*	*5*	*6*
a	1	1	10%							
b	2	1	10%							
c	2	2	10%							
d	1	2	10%							

Conclusion

1. Sketch a graph of each test, showing the PV change and output change.

i.e. Δ PV

Δ Output

Test (a)

Test (b)

Test (c)

Test (d)

2. If the controller gain is changed, but integral time is not changed, will the integral response change? Briefly explain.

____

____

____

____

Suggested duration
1½ hours

Task
To check reset wind-up and derivative bump of a typical controller in a feedback loop.

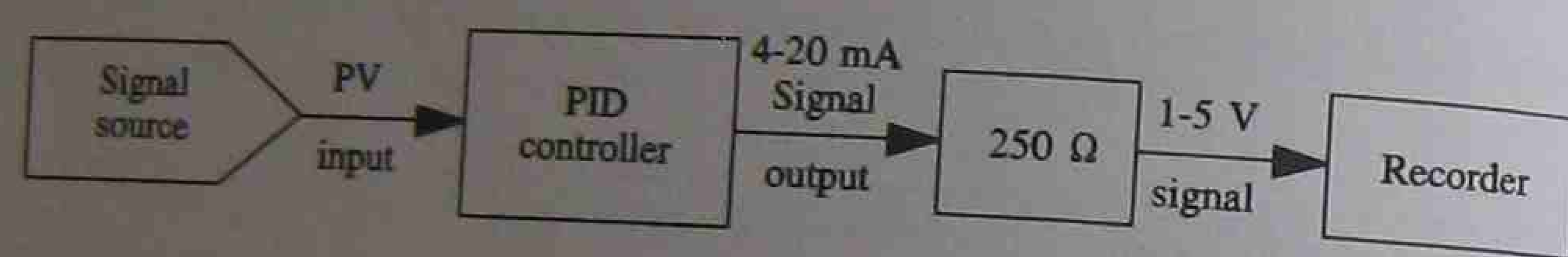
Equipment
- Typical PID controllers
- Signal source
- Three pen flat bed recorder
- Instruction manual
- 250 Ω precision resistor

Procedure

Open loop checks

1. Refer to the connection schematic and instrument manual, and sketch the connection diagram required. (Show terminal/connection numbers and polarities).

Connection schematic

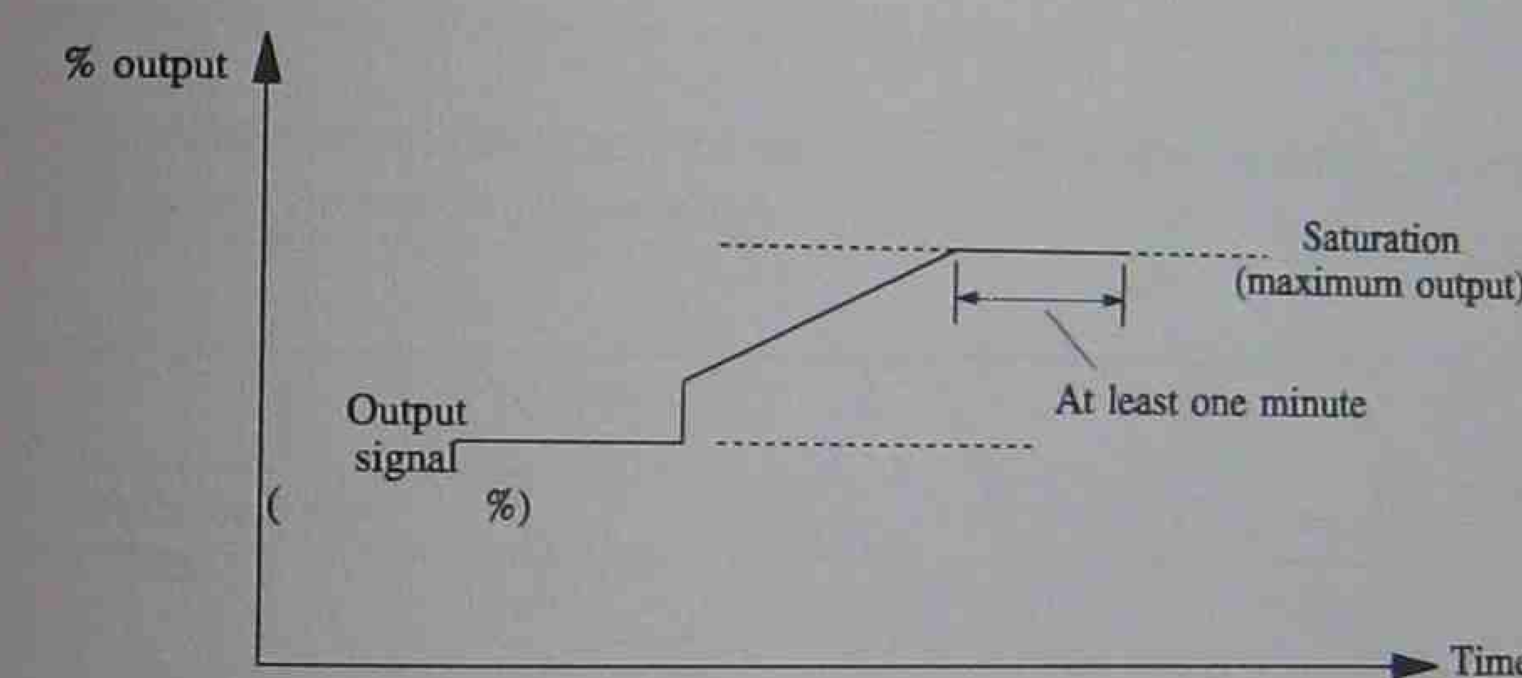


Connection diagram

2. • Turn off I and D, and set controller gain = 1.
   • Turn controller to manual, adjust output signal to 0% and then 100% and set up recorder to a suitable range. Change controller output by 10% and note the corresponding chart divisions.

   10% output change = ______________ chart divisions.

3. Place controller on auto.
   - Note output signal (__________ %) and chart recording.
   - Step change PV by 10%.
   - Note output signal (__________ %) and chart recording. The chart record should show a step change.
4. Return PV to equal the set point.
   - Set integral time to one minute.
   - Note output signal (__________ %) and chart recording.
   - Step change PV by 20% so that the output signal increases.
   - Note output signal change, and observe the chart recording. Allow the output signal to ramp up until it saturates and 'stabilises' for at least one minute (as shown below).



5. • Return the PV to the set point in 5% increments, and note the response of the output signal on the recorder chart.
   • Change the PV to the other side of the set point (by 20%), and observe the response of the output signal on the recorder chart.

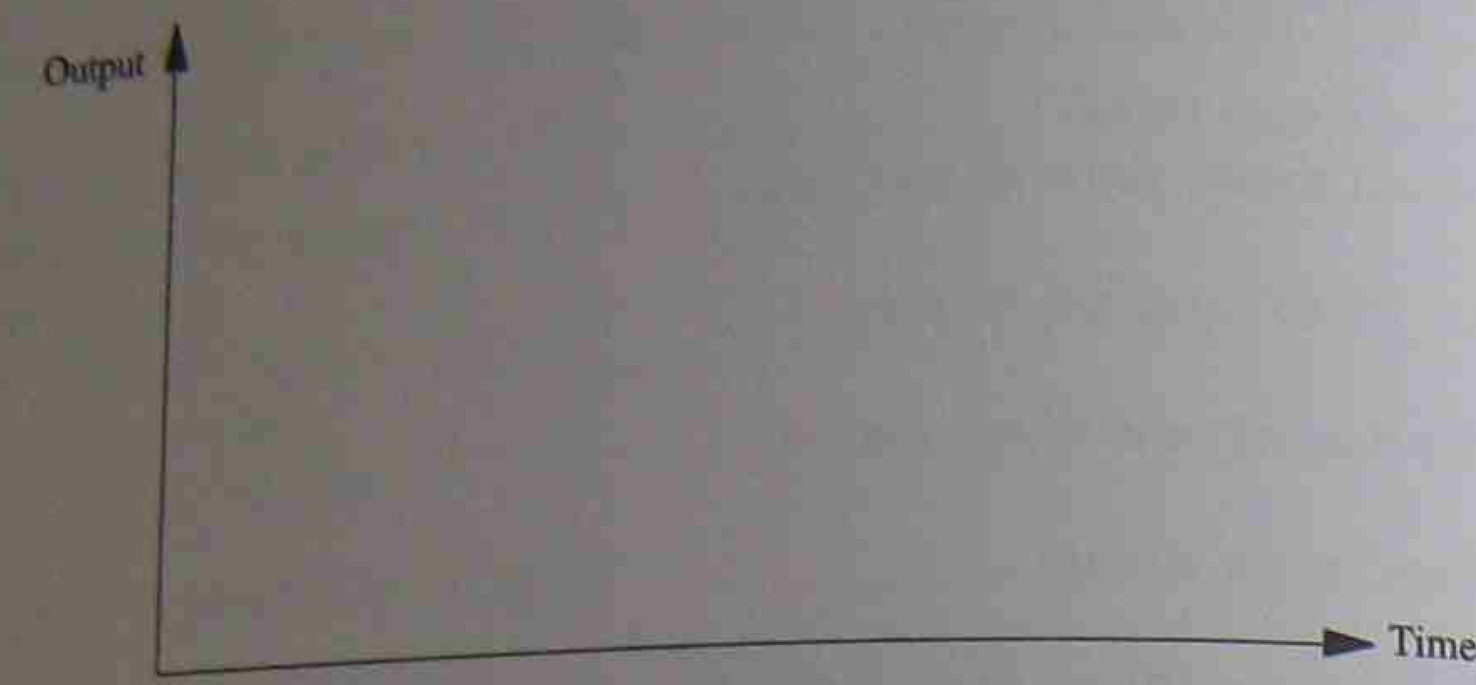
Explain your results to the instructor.

Teacher check

1st try	*2nd try*

Sketch the chart response as observed above in point 5.

Sketch of reset wind-up



Conclusion
Briefly comment on the effect of derivative bump, and reset wind-up in practical control loop situations.

____

____

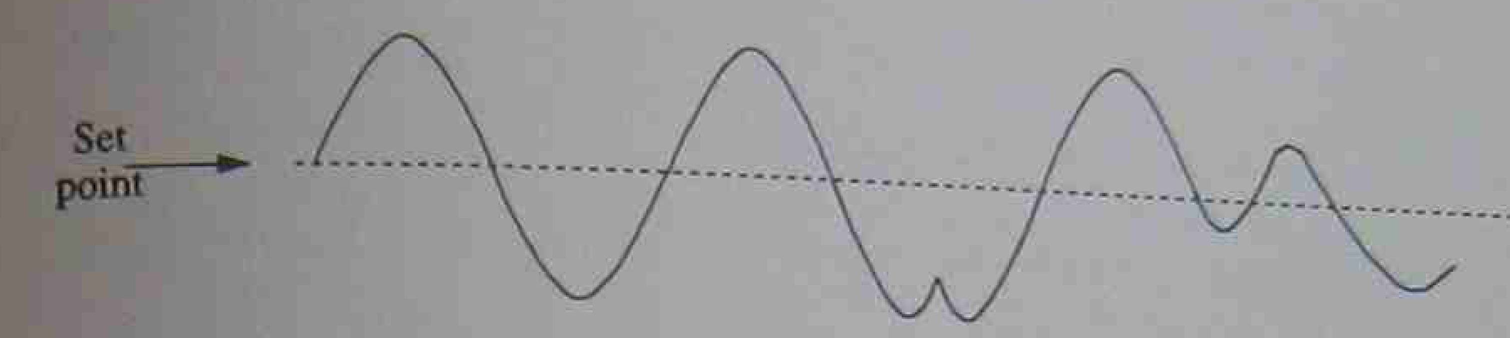
____

____

Review questions

These questions will help you revise what you have learned in Section 1.

1. Complete the output graph for an on-off controller for the following process variable graph. (No differential gap).



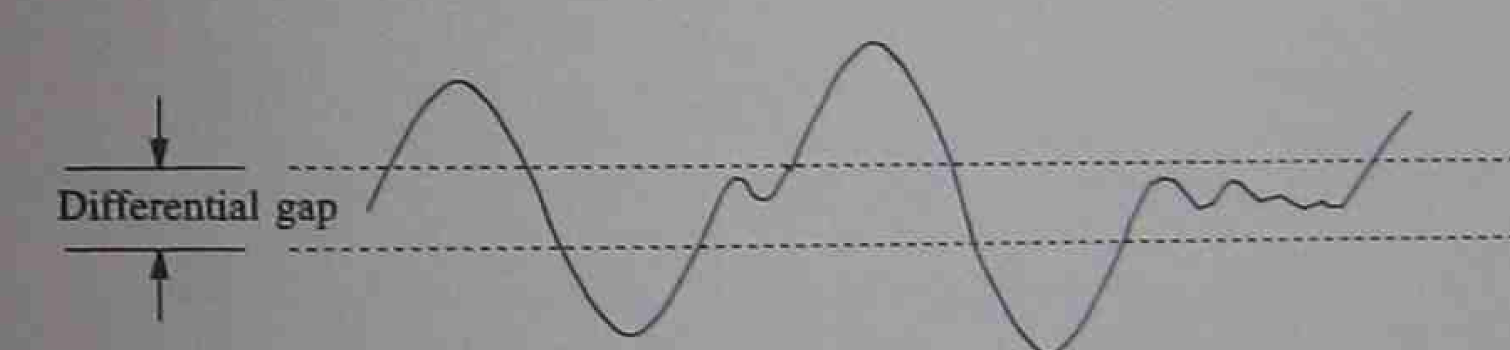
Output

ON ____

OFF ____

Note: (Output goes off when PV goes above set point).

2. Complete the output graph for an on-off controller with differential gap, for the following process variable graph.



Output

ON ____

OFF ____

3. State the effect of control loop deadtime on the *period* of the PV cycle.

____

____

____

____

4. State the effect of the process time constant, on the amplitude of a process cycling under automatic control.

5. Explain how the deadtime of a control loop affects the period of the PV cycle.

6. (a) Explain why the process time constant affects the amplitude of a process cycling under automatic control. (Use a PV graph in your explanation).

(b) State and explain the types and characteristics of processes suited to on-off control.

7. Sketch a schematic of a simple bellows operated on-off controller (e.g. pressure switch), and explain its adjustments and operation.

8. Sketch a basic on-off pressure control loop showing a pressure switch, relay and compressor.

9. Sketch a pneumatic force-balance proportional controller, showing all components.

10. Sketch an op-amp circuit to provide proportional control action.

11. Explain how the 'error signal' is derived in a process controller.

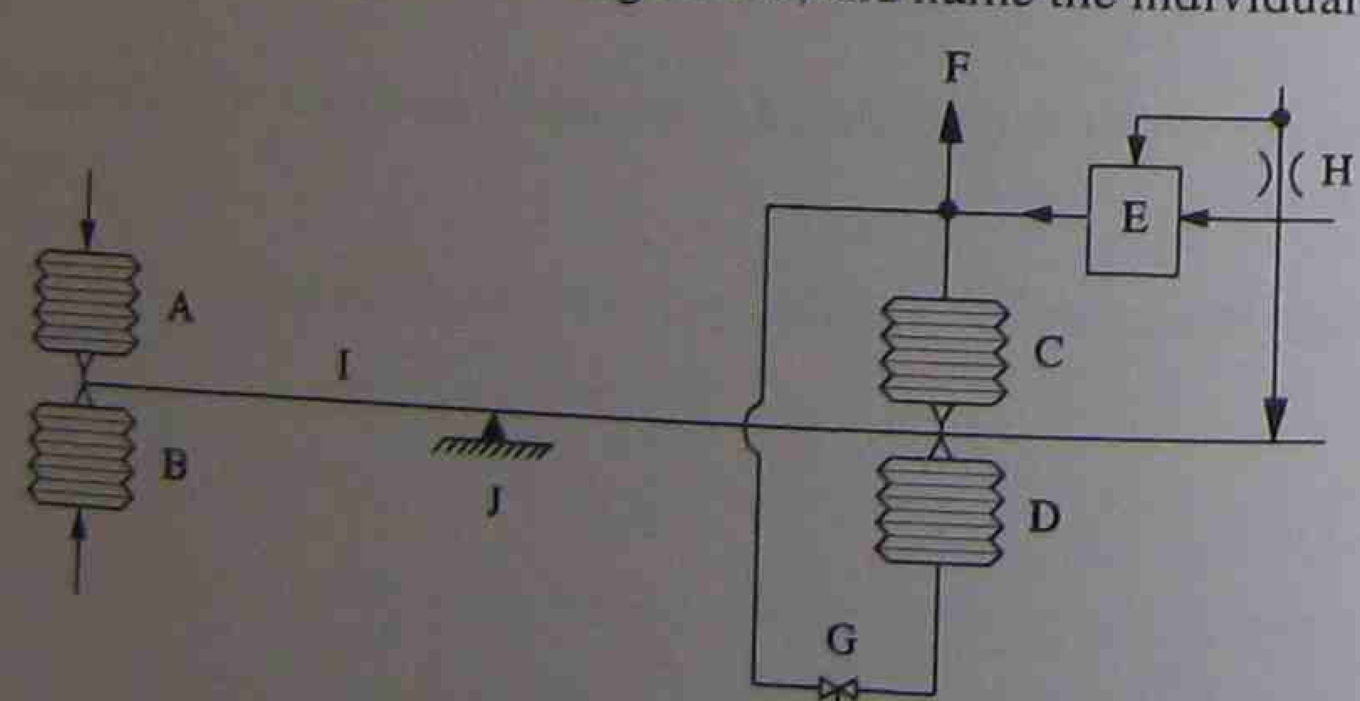
____

____

____

12. Sketch a circuit diagram to show how the error signal may be derived in an electronic (op-amp) controller.

13. (a) Name the following direct-acting device, and name the individual components.



Name of device: ______________________________

Name of components:

A ______________ F ______________

B ______________ G ______________

C ______________ H ______________

D ______________ I ______________

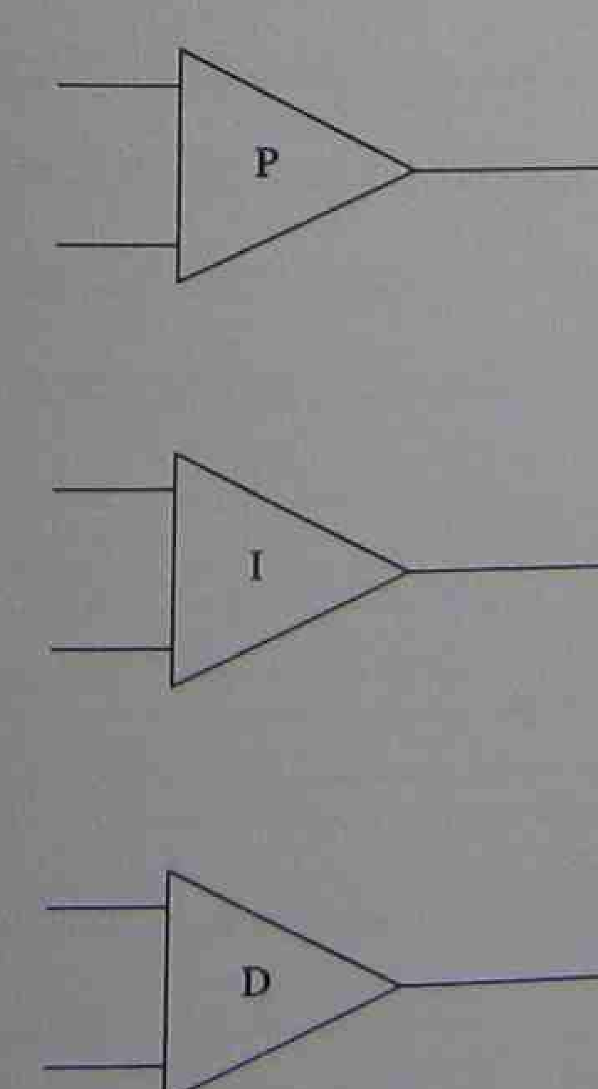
E ______________ J ______________

(b) How is the device above changed to reverse acting?

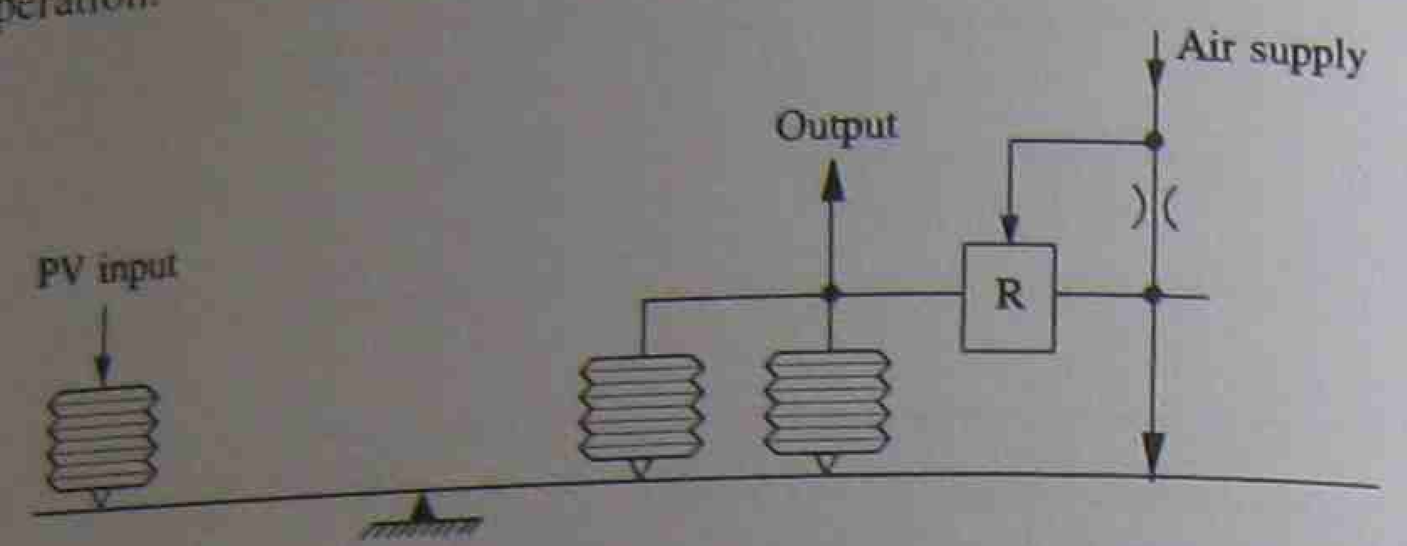
____

(c) Redraw the device above, using the alternative representation - with all the bellows on the same side of the force bar.

14. Complete the following op-amp circuits, to provide proportional, integral and derivative action, as labelled.



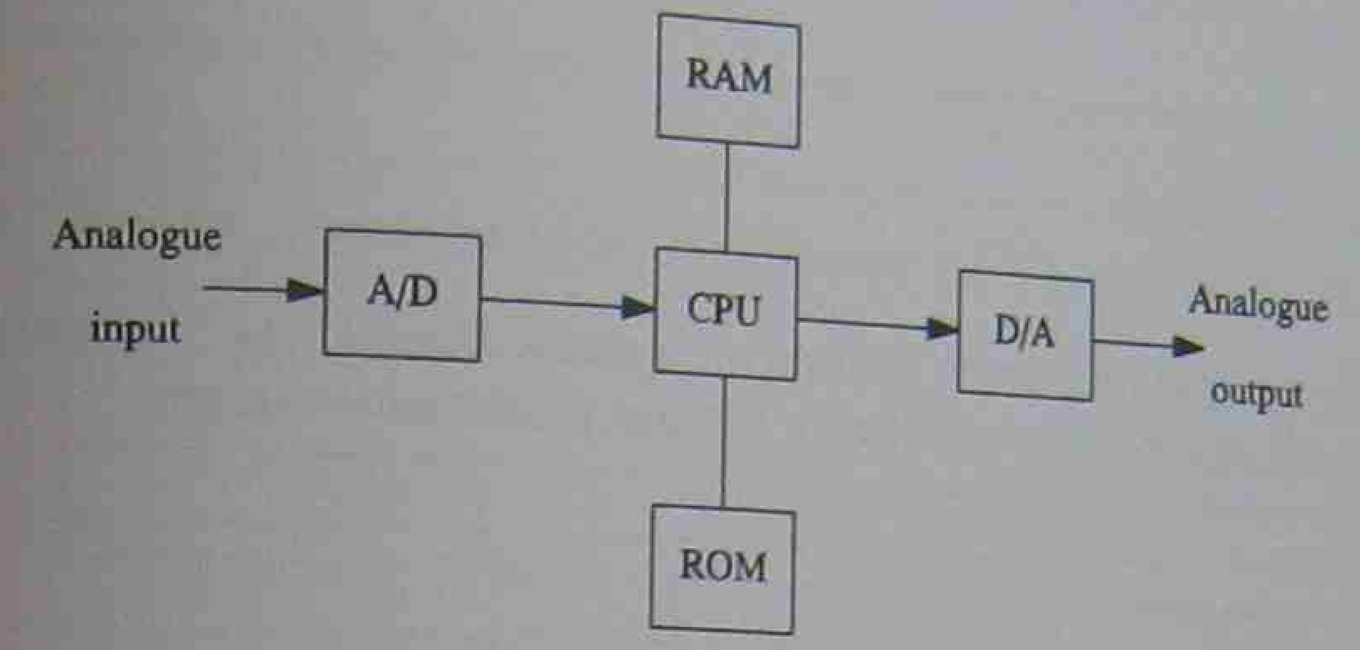
15. State the control function that is performed by the following device, and explain its operation.



Control function: ____________________

Operation: ____________________

16. Shown below is a block diagram of a basic microprocessor controller. Explain the function of the various components.



A/D ____________________

CPU ____________________

RAM ____________________

ROM ____________________

D/A

17. Write a simple program to perform proportional control. (i.e. list the steps taken by a microprocessor controller, to perform proportional control).

18. Arrange the following controllers in order improved performance and facilities.

(a) Configuration microprocessor process controller.
(b) Pneumatic controller without bumpless transfer.
(c) Pneumatic controller with derivative applied to the PV signal.
(d) Analogue electronic controller (split architecture).

Performance	*Controller (a, b, c or d)*
Basic performance 1	
2	
3	
4	

19. State the most common application of on-off control.

20. How does the process time constant influence the selection of on-off control?

21. What is the purpose of the adjustable 'differential gap' provided on some on-off controllers. (e.g. consider a pressure switch).

22. In a feedback control loop, the controller makes a correction that relates to the error in some way.

Explain the correction made by:

(a) Proportional action

(b) Integral action

(c) P and I action

(d) Derivative action

23. With respect to feedback control, explain the purpose of the:

(a) Proportional mode

(b) Integral mode

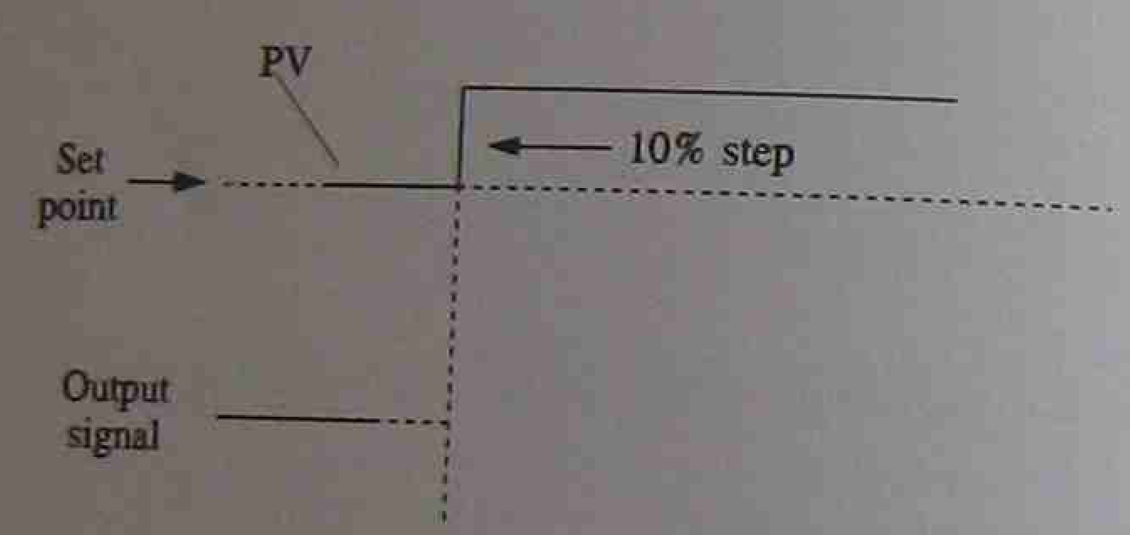
(c) Derivative mode

24. Explain the characteristics of a process that may be suited to proportional control.

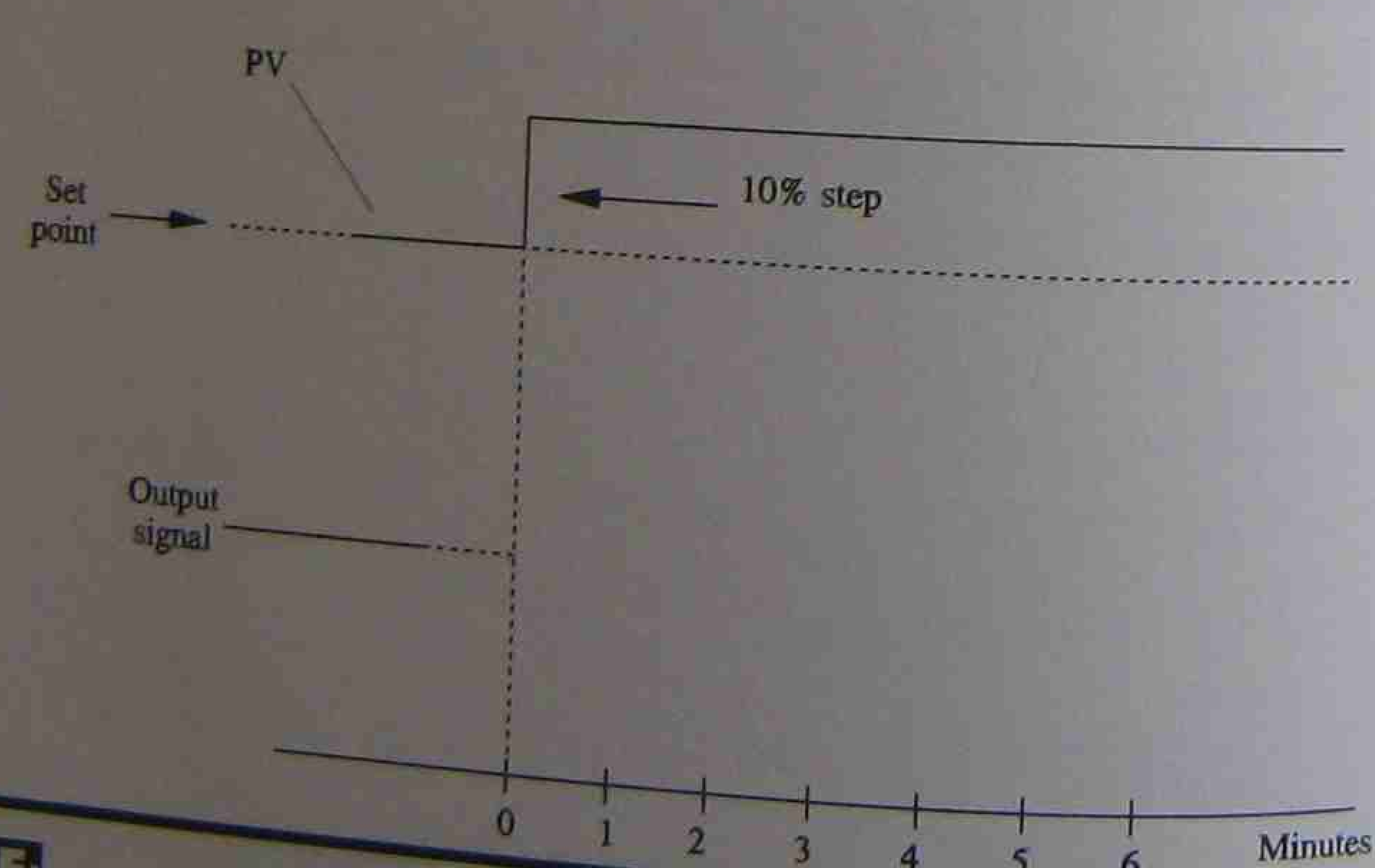
25. Explain the characteristics of a process that would require P and I control.

26. Explain the characteristics of a process that would benefit from derivative action.

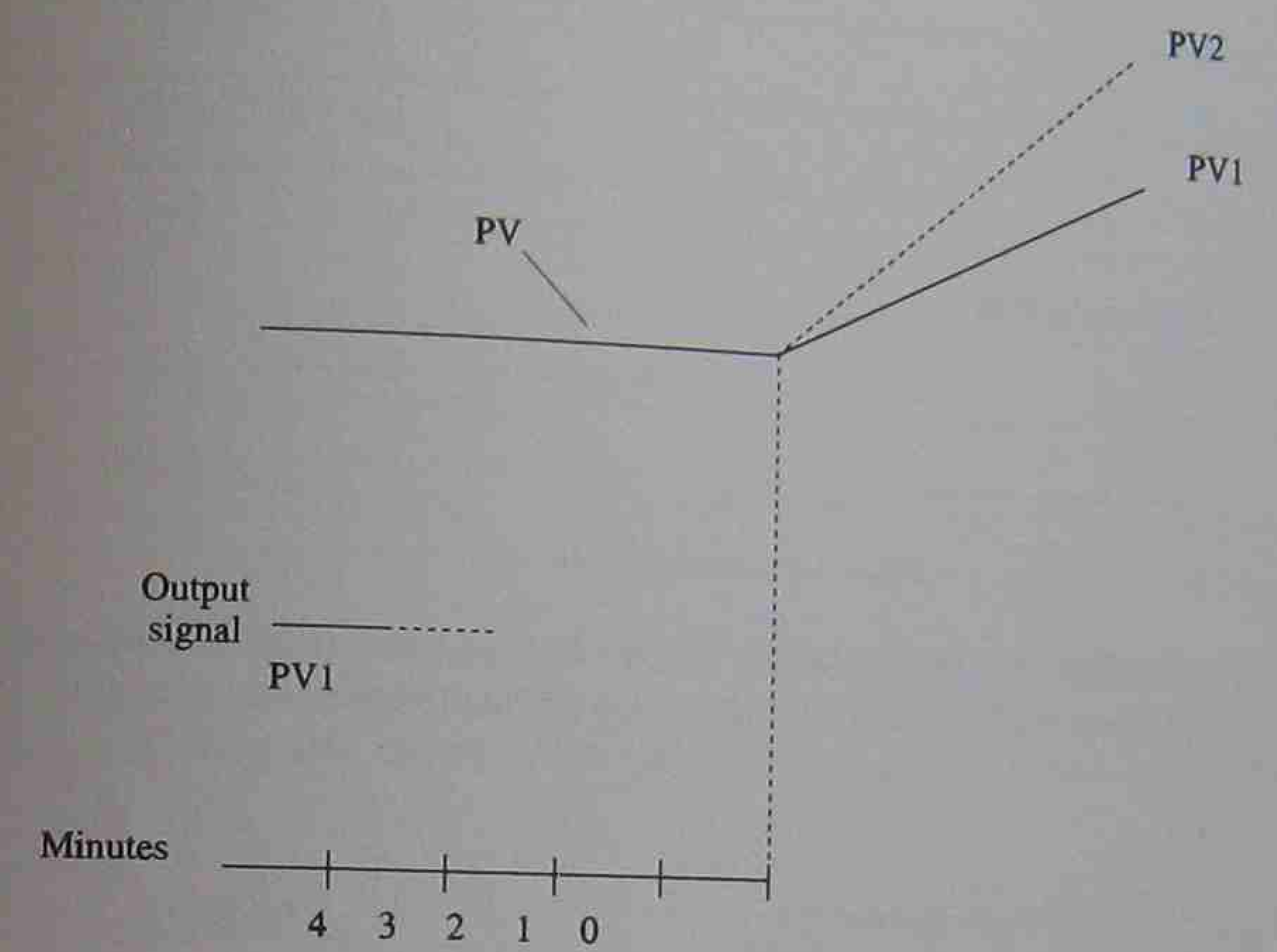
27. Complete the graph showing the output signal of a proportional controller (gain = -2) for the following PV graph.



28. Complete the graph showing the output signal of a P and I controller, for the following PV graph.
gain = +1; Ti = 2 mins



29. (a) Complete the graph showing the output signal of a P and D controller, for the following PV graph.
gain = +1; Td = 2 mins



(b) Explain how the controller response shown above, attempts to compensate for time lags in the control loop.

(c) If the rate of change (slope) of the PV as shown above, was greater (i.e. PV2): *(Tick the correct box)*

- ☐ Td would increase
- ☐ Td would decrease
- ☐ The derivative step would increase
- ☐ The derivative step would decrease.

(d) Show the output signal for PV2 on the graph on previous page.

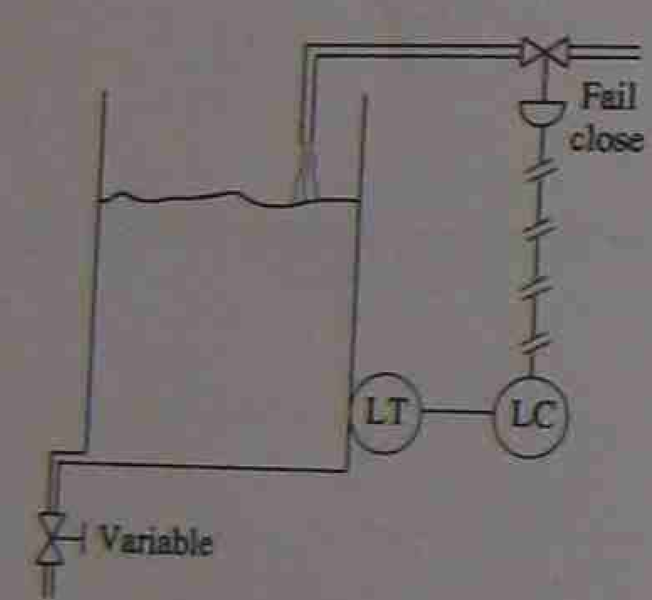
30. (a) Explain the terms, 'direct action' and 'reverse action'.

Direct action

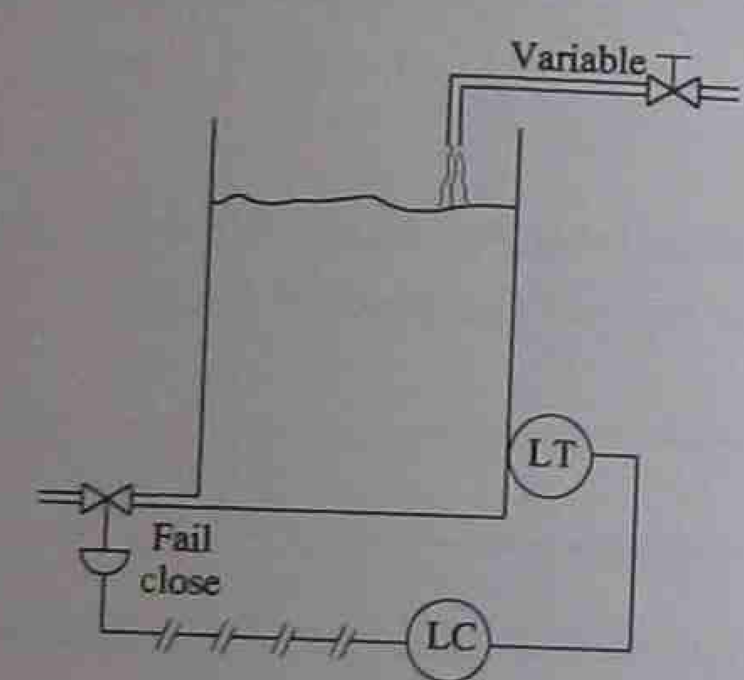
Reverse action

(b) Four control loops are shown below. Label each controller 'direct action' or 'reverse action' as is necessary to obtain feedback control.

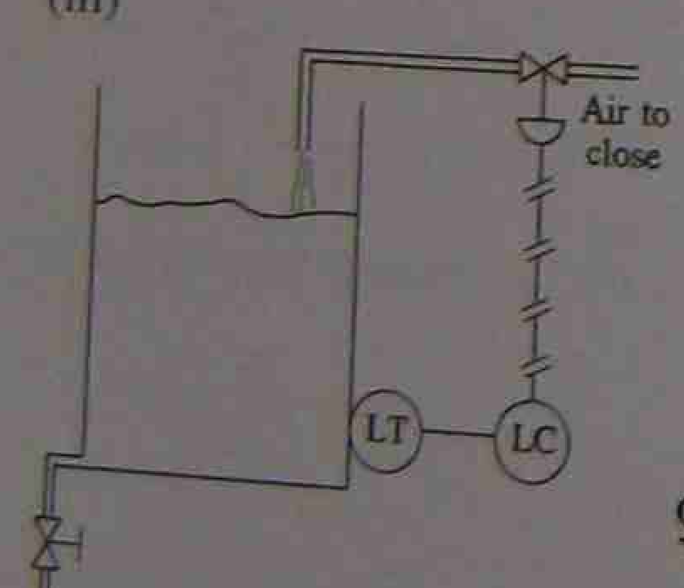
(i)



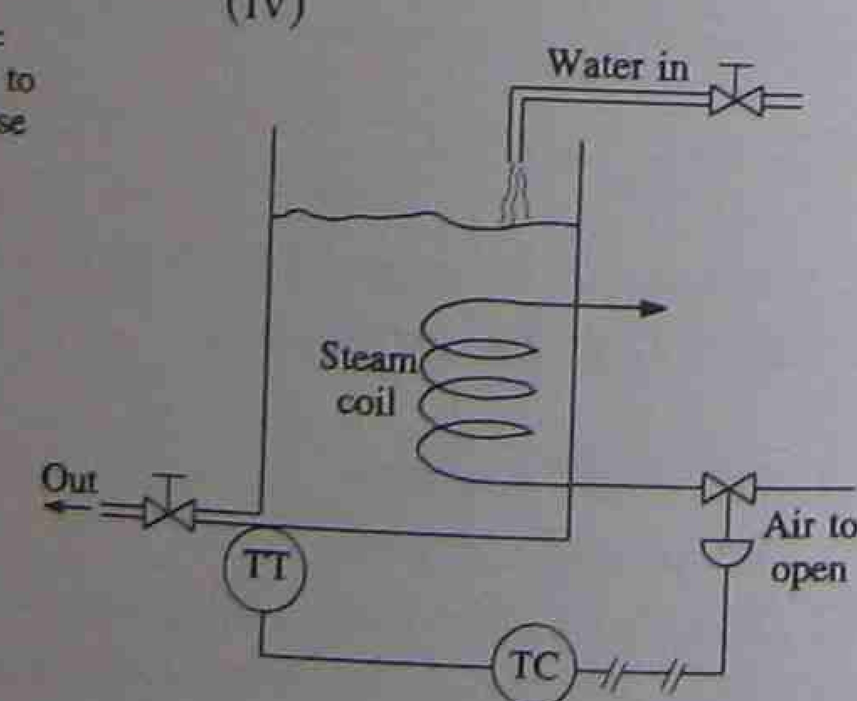
(ii)



(iii)



(iv)



(c) With regard to the temperature control loop shown, it is required that the water tank does not overheat. In the event of instrument air failure (loss of air), is the control loop shown 'failsafe'?

- Yes/No
- Why/Why not

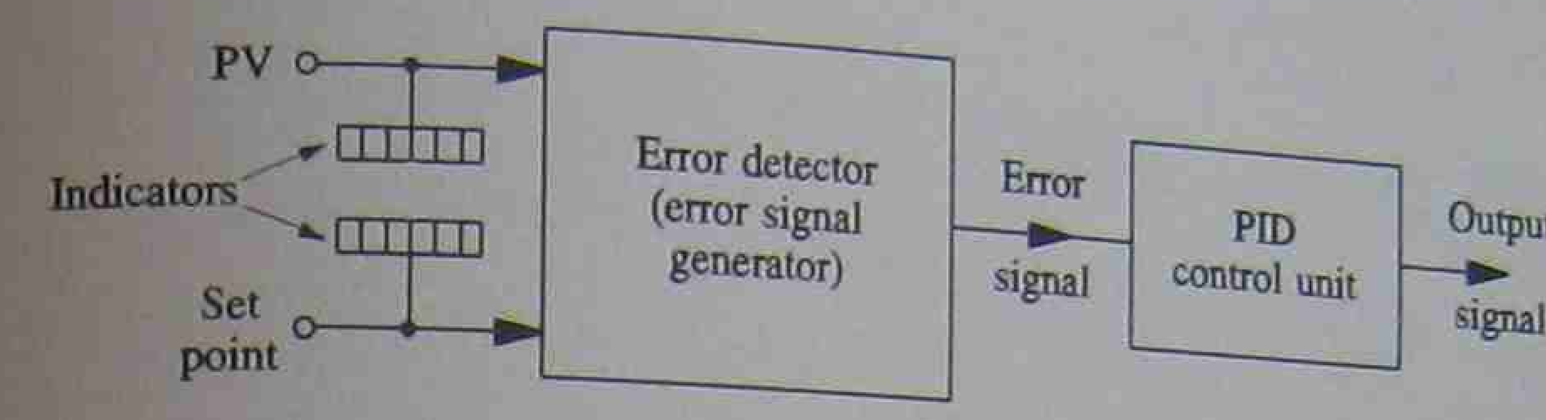
31. How does a temperature controller with a relay output, *not* analogue output (used for example to switch a heating element), provide proportional control? Provide switching diagrams showing, low gain and high gain responses to an error.

32. Explain what 'bumpless transfer' is, and explain its purpose.

33. Explain 'set point tracking' and explain its purpose.

34. Explain local/remote set points, and state **two** common applications of the remote set point option.

35. Refer to the diagram below, and answer the following questions.



(a) When the error signal is say 1%, what is the change to the output signal due to proportional action:

(i) when controller gain = 1? ________

(ii) when controller gain = 2? ________

(iii) when controller gain = 10? ________

(b) When the error signal is 1%, and the controller gain is varied from 1 to 10, what happens to the output signal?

(c) When the error signal is zero, and the controller gain is changed, what happens to the output signal?

(d) When the PV equals the set point, what is the error signal?

(e) If the PV equals the set point, but the error signal is *not* zero, the controller is not correctly adjusted. We call this fault an ________ fault.

36. A controller is out of alignment and PV equals the set point. *(Circle True or False)*

(a) An error signal is caused. True/False

(b) The controller will control with an offset. True/False

(c) Derivative action will take place. True/False

(d) Integral action will operate to eliminate the offset. True/False

(e) If the gain is changed, the offset will change. True/False

37. What conditions/procedures are required to align a controller? (Refer to the diagram in question 35 to explain your answer.)

Section 2: Control strategies and controller configurations

SUGGESTED DURATION	PURPOSE
11 hours	This section deals with the application and operation of various control strategies and with the principles and application of controller configurations.
This section covers learning outcomes 5 and 6 of the National Module Descriptor.	

Objectives

At the end of this section you should be able to:

- ☐ explain the application, characteristics, and operation of ratio, cascade, feedforward and batch control systems
- ☐ check and adjust the operation of various control systems
- ☐ describe typical configuration methods and interpret configuration diagrams
- ☐ configure controllers to provide various control strategies and check the operation of the configuration.

Skill practice 4: Controller configurations

Suggested duration

2 hours

Task

To check and program common configurations on a microprocessor-based PIC controller. Configurations such as ratio, cascade, feedforward, console-local operation and rotor with console-local operation should be checked and configured.

Equipment

- Microprocessor-based PIC controller
- Manual for controller
- Manual for controller configuration
- Two input signal sources

Procedure

Note: These procedures have been written in general terms in order to make the tools suitable for a range of configurable microprocessor controllers.

You will program and check the operation of at least three standard (factory) configuration on the available controllers.

The teacher will nominate the configurations (A, B, C) to be used and you will record these in the space below.

A ______________________

B ______________________

C ______________________

Some examples of configurations that may be checked are:

- external setpoint PID controller
- ratio set PID controller
- ratio set PID controller with console/local operation
- cascade control.

For each of the configurations nominated you will:

1. Refer to the instrumentation/configuration manual and examine the appropriate diagrams and descriptions of the given configuration.
2. Program the controller to operate in the given configuration.
3. Connect signal source/s as appropriate.
4. Vary input signals/ and check operation of the configuration.

5. Explain the purpose and operation of each of the configuration setups.

Configuration A

Configuration B

Configuration C

For configurations D or E, if time permits, attach additional pages.

Conclusion

1. Comment on ease of programming.

2. Comment on similarities and differences between similar configurations - e.g. between ratio set PID controller and ratio set PID controller with console local operation.

Skill practice 5: Ratio and cascade control

Suggested duration

2 hours

Task

To examine the operation of real and/or simulated processes employing various control strategies (such as ratio or cascade).

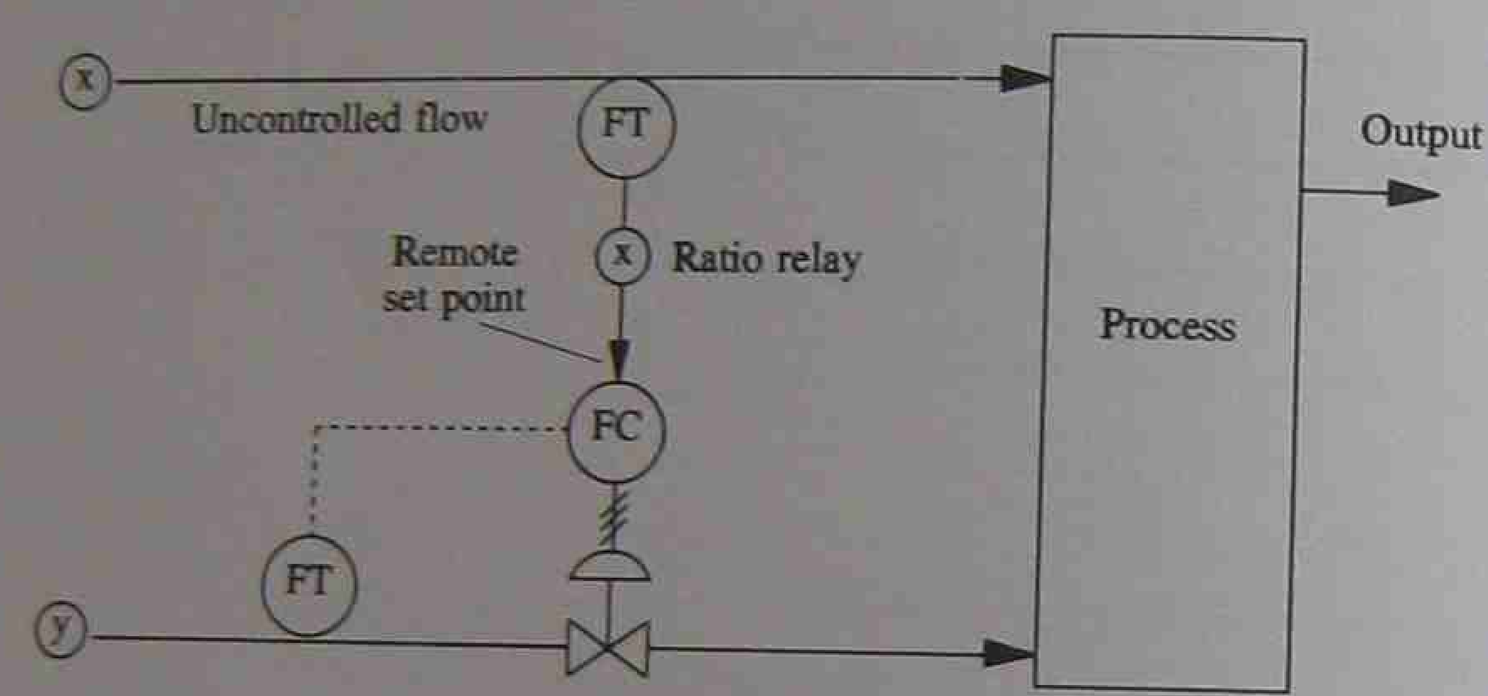
Equipment

- Process plants and or process simulators
- Test equipment

Note: These procedures are presented as general examples. Local equipment and facilities will determine the exact nature of the tasks performed. Also, the control loops should be pre-tuned, as tuning of loops is covered in Section 3.

Procedure

Part A Ratio control loop (e.g. flow A and B)



1. (a) Examine the P (Process) and I (Instrumentation) diagram above and compare this with the plant and instrumentation that you are using.

   (b) List the instrumentation installed in the loop.

   ____

   ____

   ____

   ____

2. Start up the plant on manual.

3. Vary the wild (uncontrolled) flow and check the operation of the remote set point.

4. Set the ratio to a suitable value and check operation.

5. Switch to automatic, vary the wild flow and observe the operation of the controlled flow part of the loop.

6. Briefly explain the operation of this loop.

   ____

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   ____

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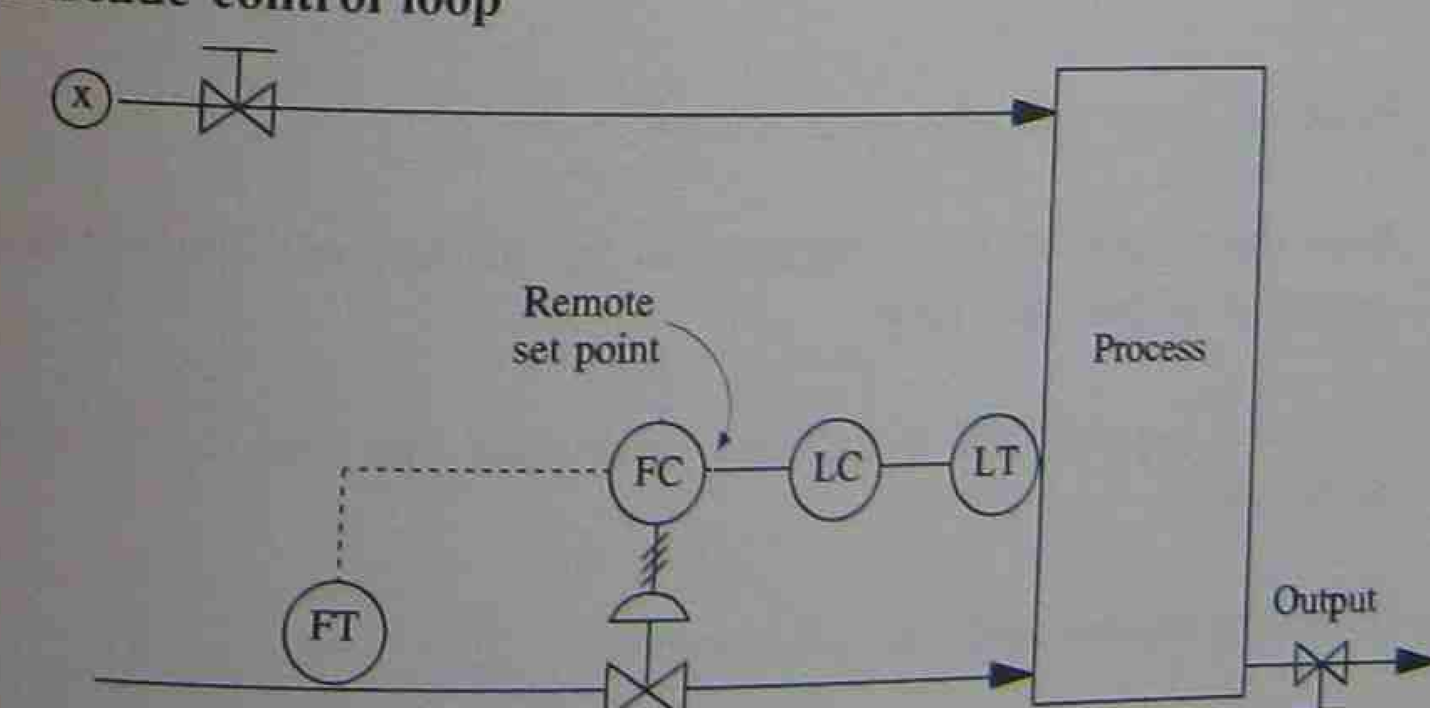
   ____

7. Sketch the loop diagram as installed.

Part B Cascade control loop



1. (a) Examine the P and I diagram above and compare this with the plant and instrumentation.

(b) List the instrumentation installed in the loop.

(c) Sketch the loop as installed and label the master and slave controllers. Have teacher check.

1st try	2nd try

2. (a) Start up the plant with both controllers on manual.

   (b) Vary the manual output of the master and check the operation of the slave set point.

3. (a) Place the slave controller on automatic.

   (b) Vary the remote set point signal from the master and observe and note the operation of the slave loop.

   (c) Create a supply side disturbance and note that the slave loop operates correctly.

4. (a) Place the master controller on automatic.

   (b) Create a load disturbance and observe the operation of the cascade control loop.

5. Comment on your observations, and briefly explain the operation of cascade control loops.

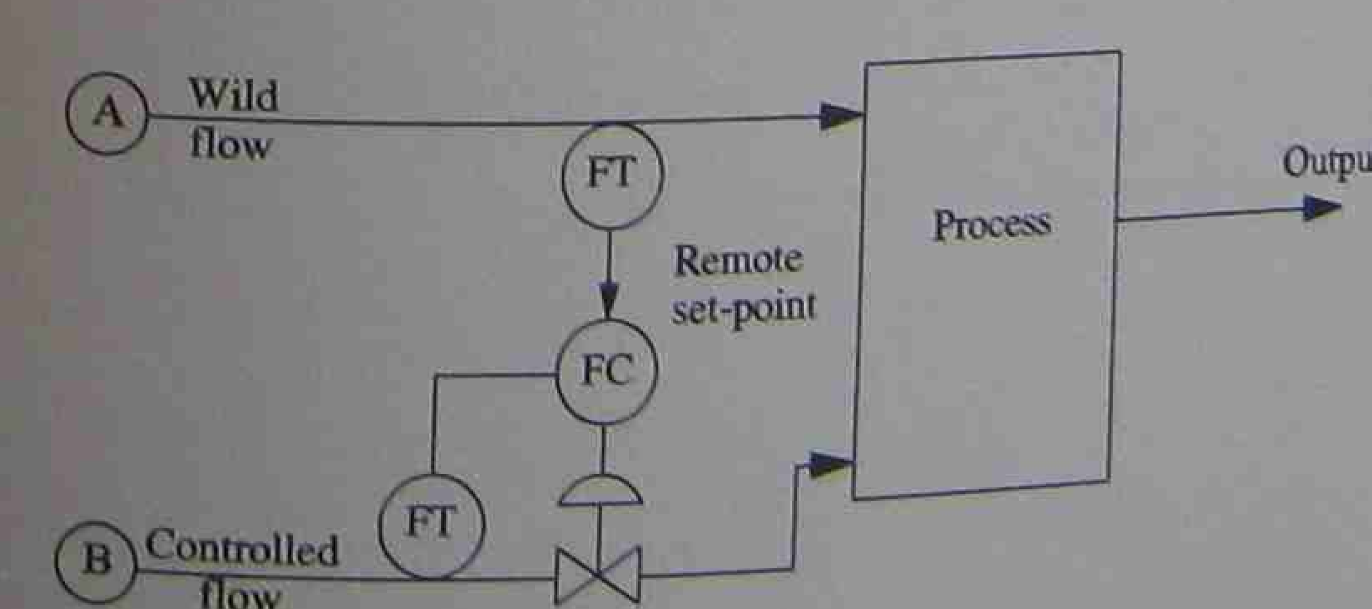
Notes

Review questions

These questions will help you revise what you have learned in Section 2.

1. Provide a block diagram of a basic feedback control loop, and briefly outline its principle of operation.

2. A basic ratio control loop is shown below. Briefly outline its principle of operation, and state **two** common applications of ratio control.



Operation: ______________________________

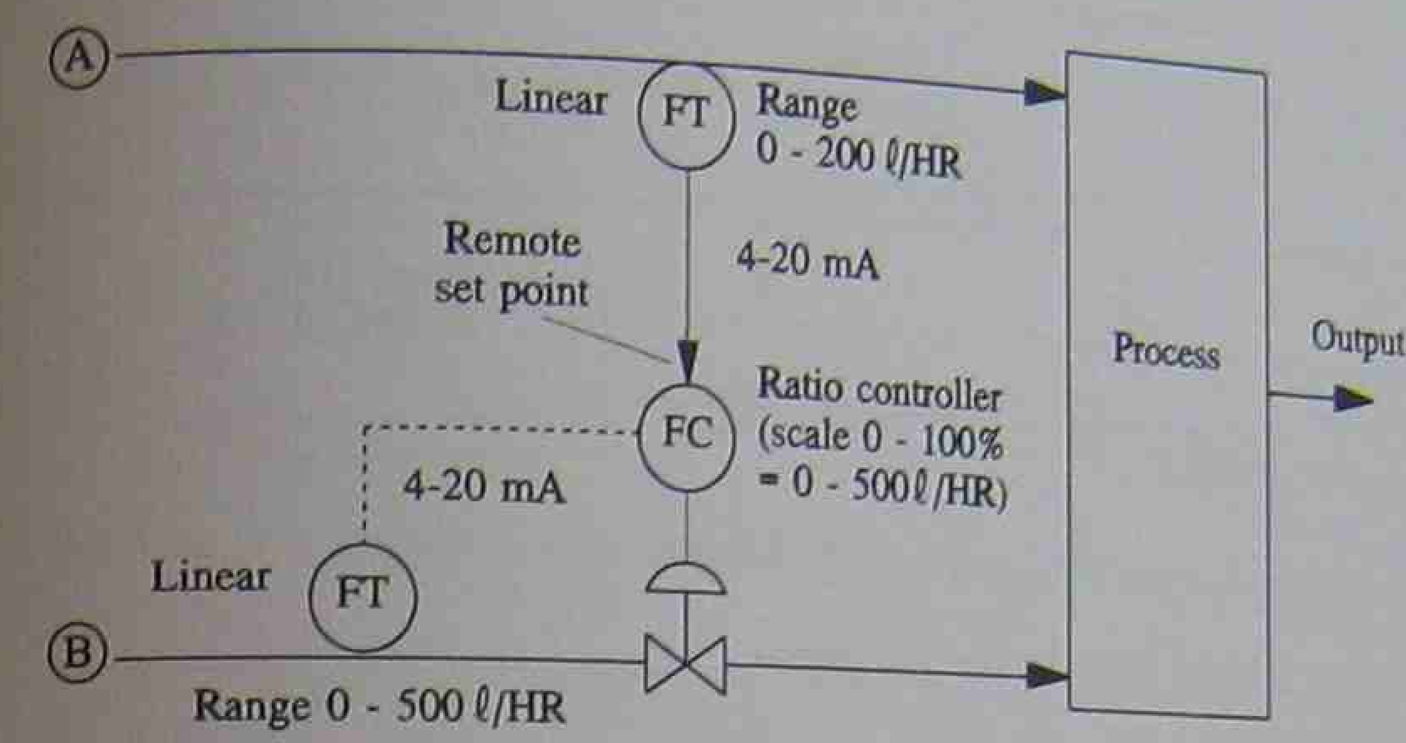
Applications:

- ______________________________
- ______________________________

3. With regard to ratio control, in practice, a 'ratio relay' or a controller, with an adjustable ratio function, is used. Redraw the diagram in question 2, showing a ratio relay, and explain its purpose.

Purpose: ______________________________

4. A ratio control loop is shown below. Examine the diagram, and answer the following questions.



(a) The ratio is set to 1:1 (X1), if flow (A) increases by 20 ℓ/HR, then

(i) The remote set point signal will increase by ________ %.

(ii) Flow (B) will increase by ________ %,

i.e. by ________ ℓ/HR.

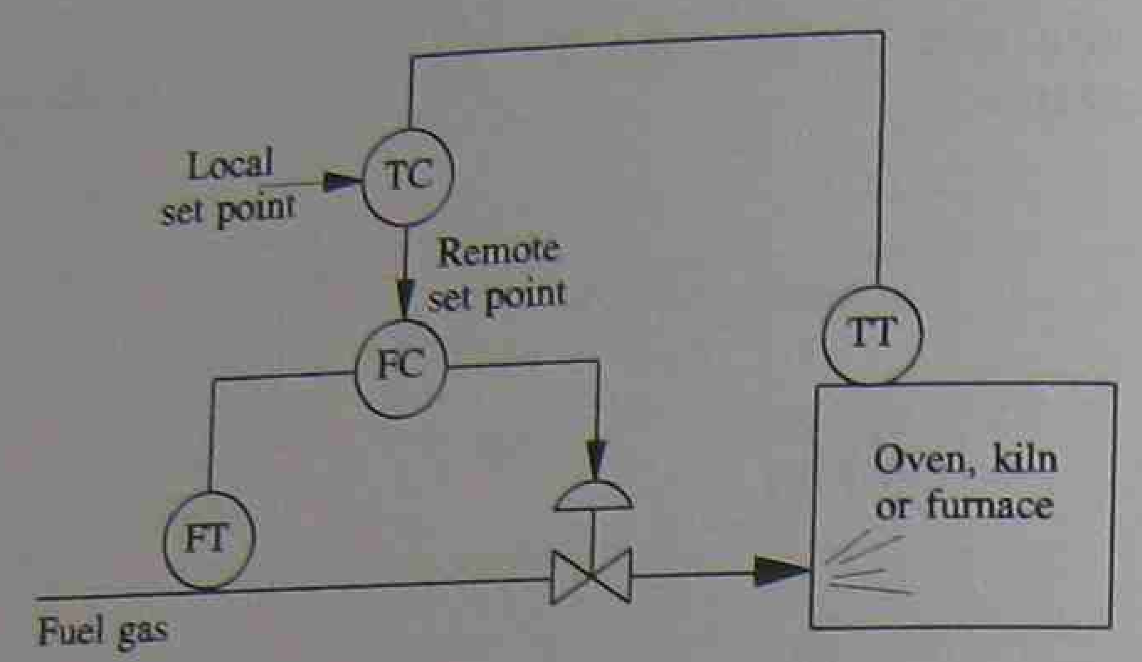
(iii) This is the ratio of $\frac{\textit{Flow } (B)}{\textit{Flow } (A)}$ = ________

(b) Calculate the ratio setting required to give a flow ratio of B:A = 2:1, and prove your answer.

Equation:

$$\frac{\textit{Range } (B)}{\textit{Range } (A)} \times R = 2$$

5.



A cascade control loop is shown above.

(a) Label the master controller.

(b) Label the slave controller.

(c) List the components of the slave loop.

(d) Briefly outline the operation of this cascade loop.

(e) Comment on the relative time constants of the master and slave control loops.

(f) Why may a cascade loop provide better control than a single feedback loop?

(g) Explain why a cascade control loop may be necessary on a process.

6. Feedback control requires an error, before any correction can take place. In other words, control action takes place after an error has occurred. Where this is not satisfactory, feedforward control may be used. Feedforward control can provide greatly improved process stability (but at greater complexity and cost).

(a) Sketch a simple feedforward control temperature loop, (without feedback trim).

(b) Briefly outline the principle of operation of this feedforward control loop.

(c) In practise, it is impossible to provide perfect control using a pure feedforward loop, some 'feedback trim' is usually required. Add feedback trim to the diagram in (a) above, and briefly outline its operation.

(d) Sketch a simple feedforward level control loop (without feedback trim)

(e) Explain why feedback trim would be required.

7. (a) Explain the term 'batch process'.

(b) Batch process is common in the food industry, and also in the chemical and petrochemical industry. Give **two** examples where a product is produced in batches, for each industry.

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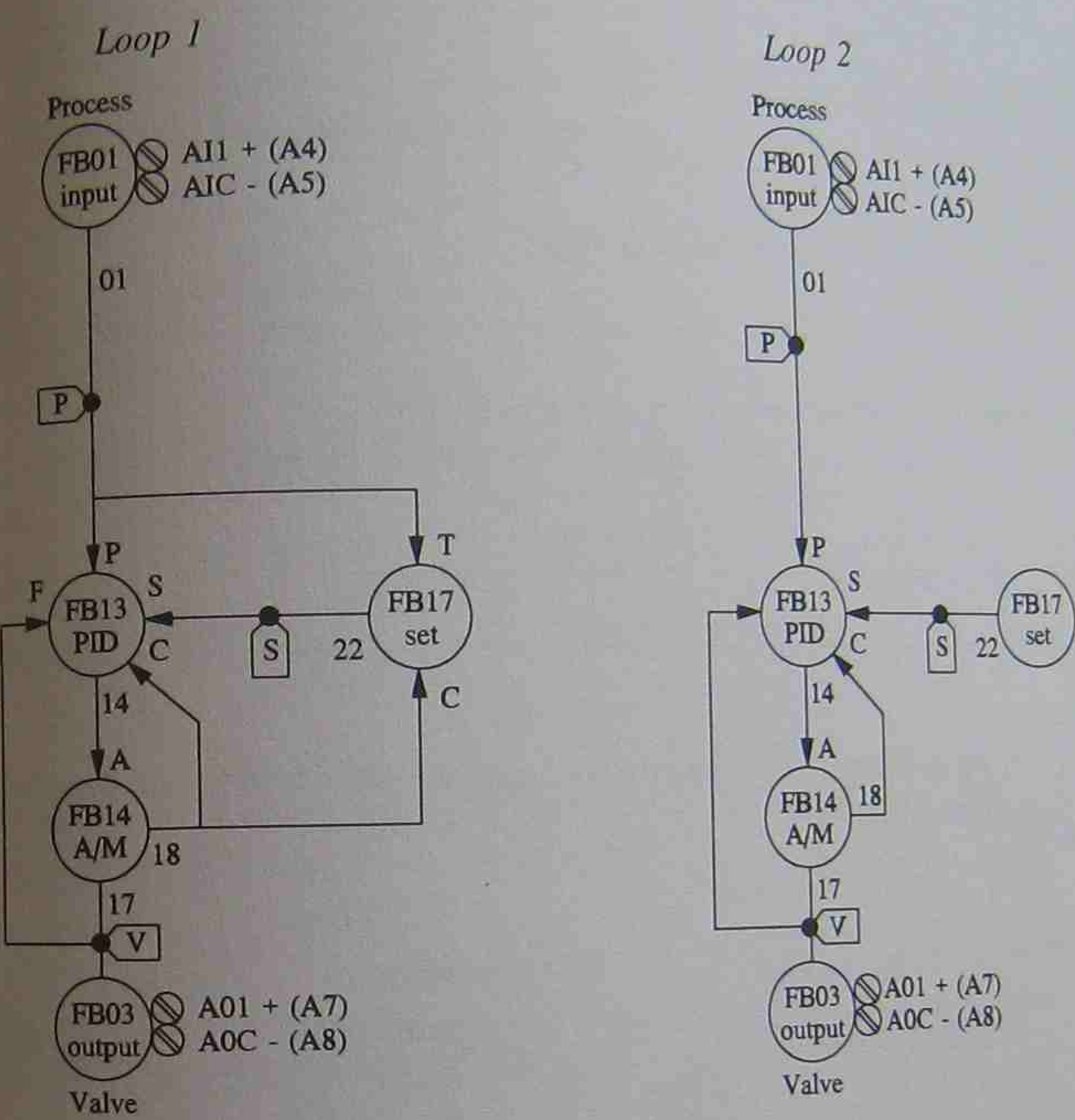
(c) Sketch a basic diagram representing a typical batch process system and briefly outline its operation. (Use three batched liquid inputs.)

(d) Explain how PLCs may be used in a batch process system.

(e) A batch process system uses both batch control and continuous control. Sketch a diagram showing a three input batch process requiring temperature control.

(f) What part of the process above uses continuous control.

8. Compare the controller configuration diagrams shown below and answer the questions following.



Connection to `display'

(a) Identify the input terminals.

(b) Identify the output terminals.

(c) Identify the controller function block.

(d) Identify the auto manual function block.

(e) State the purpose of P and V.

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(f) Identify the set point function block.

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(g) State the difference between loop 1 and loop 2.

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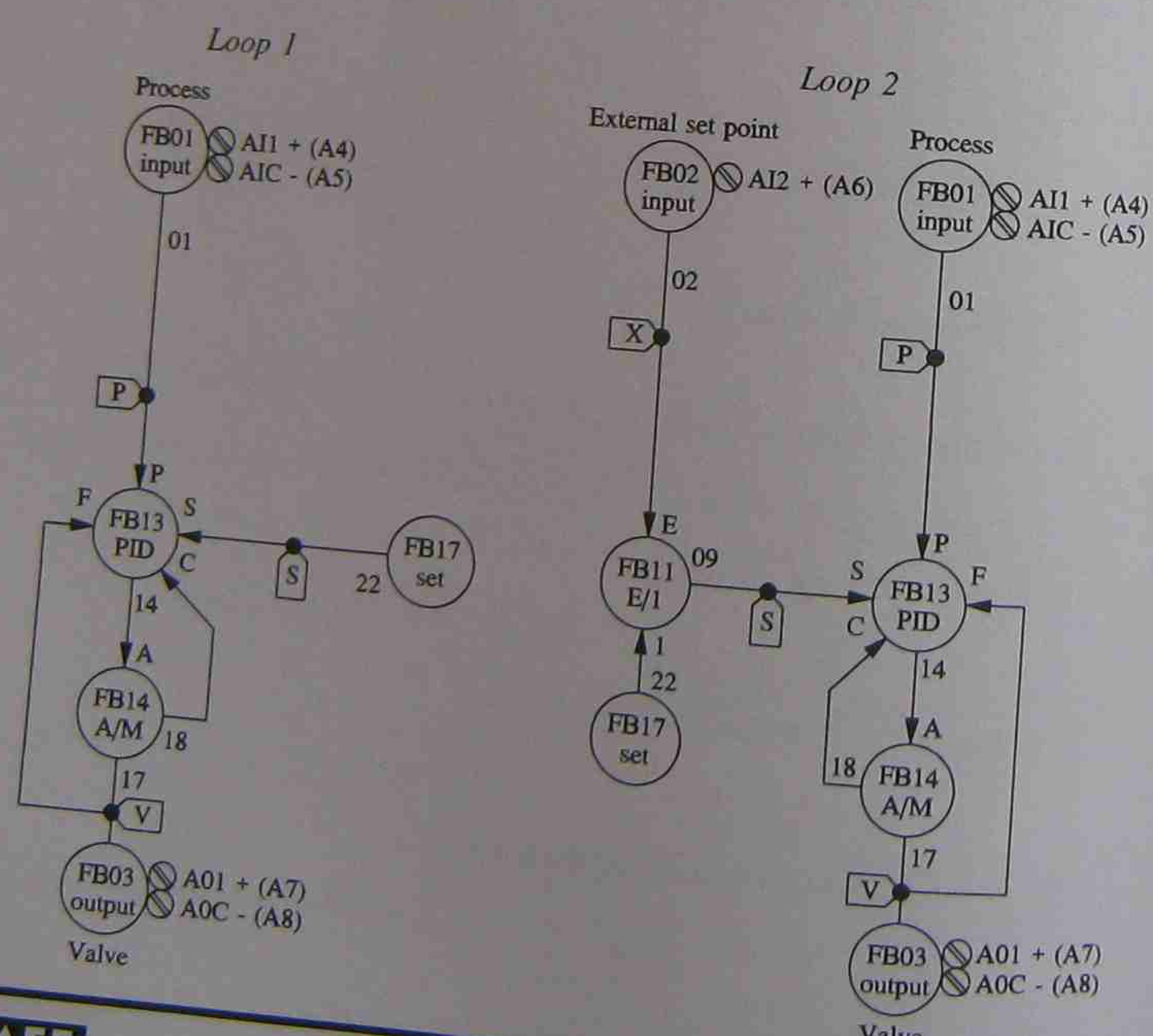
9. Compare the controller configuration diagrams shown below and answer the following questions.



(a) State the function of loop 1.

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(b) Explain how loop 2 differs from loop 1

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(c) State the purpose of function block FB11 in loop 2.

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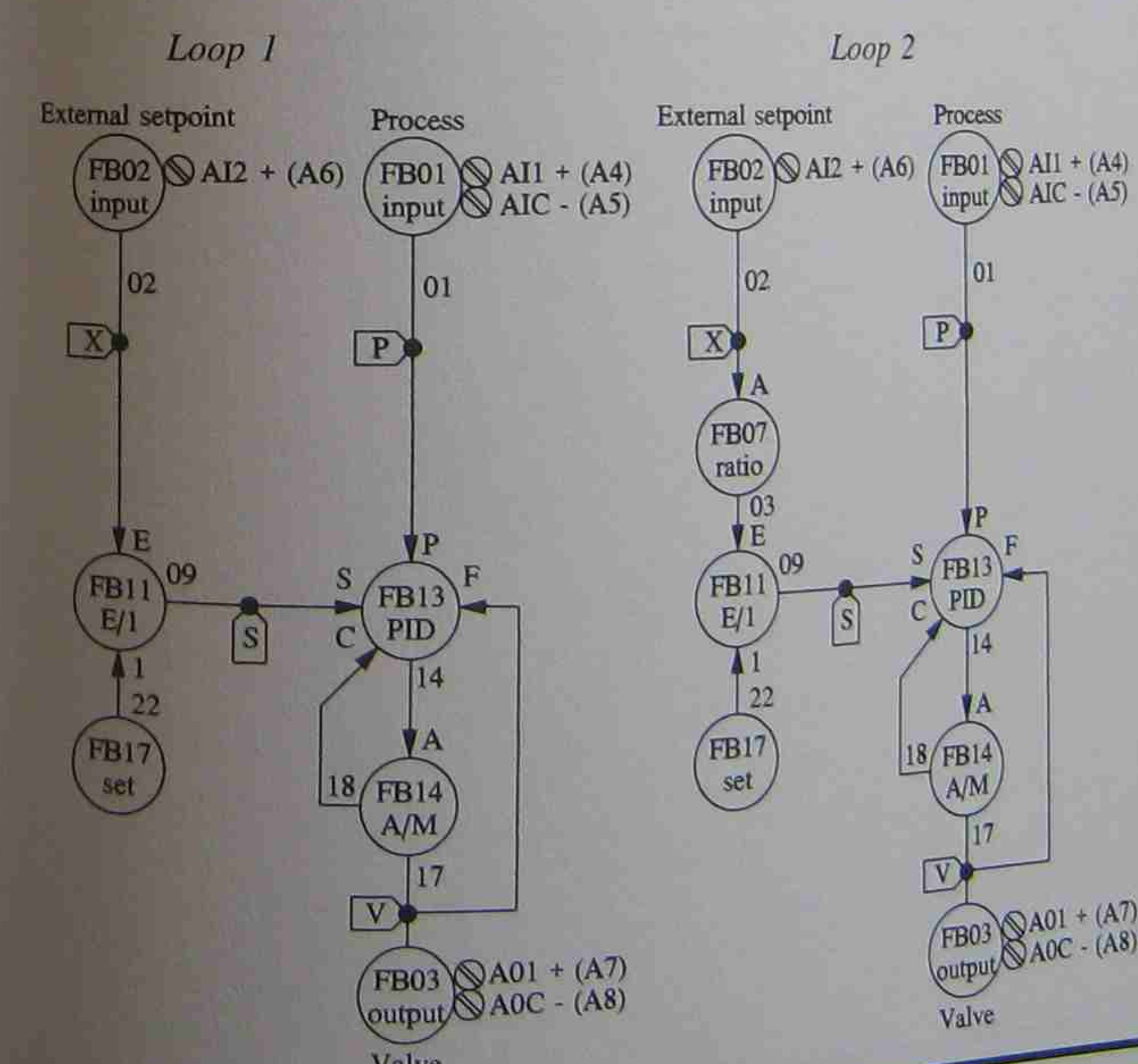
10. Compare the controller configuration diagrams shown below and answer the following questions.



Review questions

(a) State the function of loop diagram 1?

(b) What addition has been made to loop 2, compared to loop 1?

(c) What is the purpose of the loop 2 configuration?

(d) Where does the external set point signal in loop 2 generally come from?

Section 3: Tuning and installation of control loops

SUGGESTED DURATION	PURPOSE
13 hours	This section deals with installation, commissioning and tuning of control loops.
This section covers learning outcomes 4, 5, 7 and 8 of the National Module Descriptor.	

Objectives

At the end of this section you should be able to:

- ☐ outline the application of linear and equal percentage control valves
- ☐ install and commission control loop instrumentation on single or multi-variable loops
- ☐ tune typical control loops (single and multi-variable)
- ☐ configure and tune microprocessor based controllers.

Notes

Skill practice 6: Loop connection and testing

Suggested duration
2½ hours

Task
To connect the component of a typical control loop and test the loop operation.

Equipment
- Transmitter/s
- Controller (electronic)
- I/P converter
- Control valve
- Process
- Leads, wires, tubing, connectors
- Digital multimeter
- Signal source
- Calibrator

Note: This procedure is presented as a typical example of this task. Local equipment and facilities will determine the exact nature of this task.

Procedure

Part A Loop connection

1. (a) Examine the loop diagram

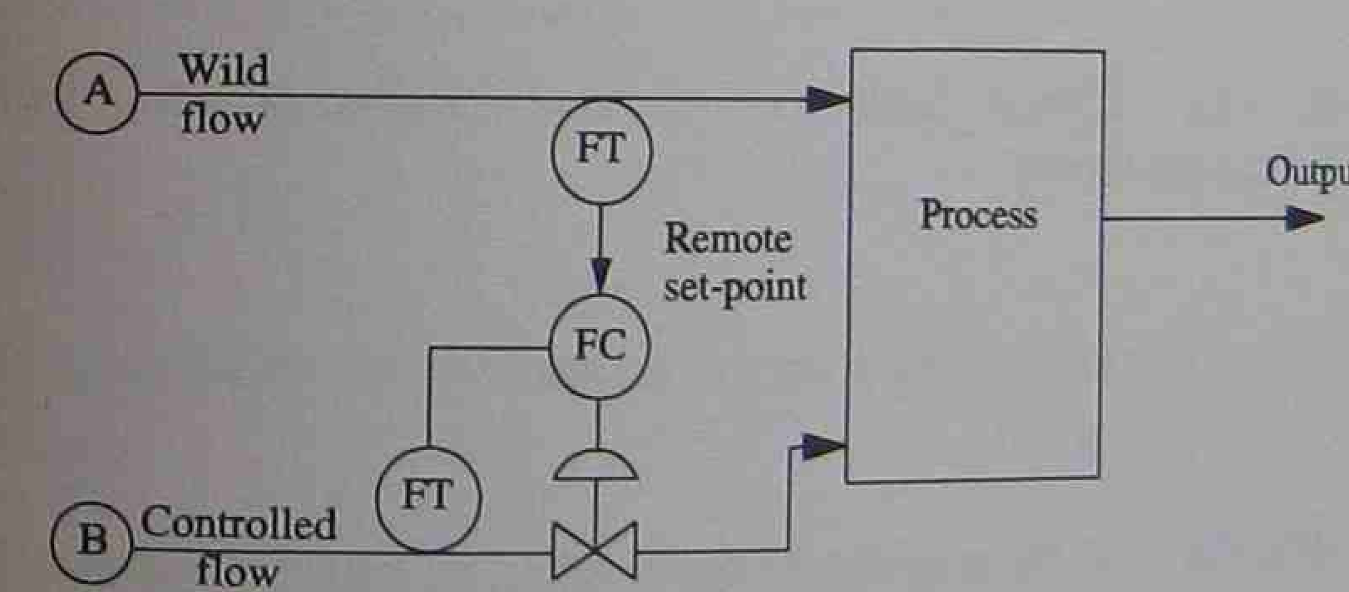


Fig. 1

(b) Name this control system.

____

(c) Examine the component and connection diagram

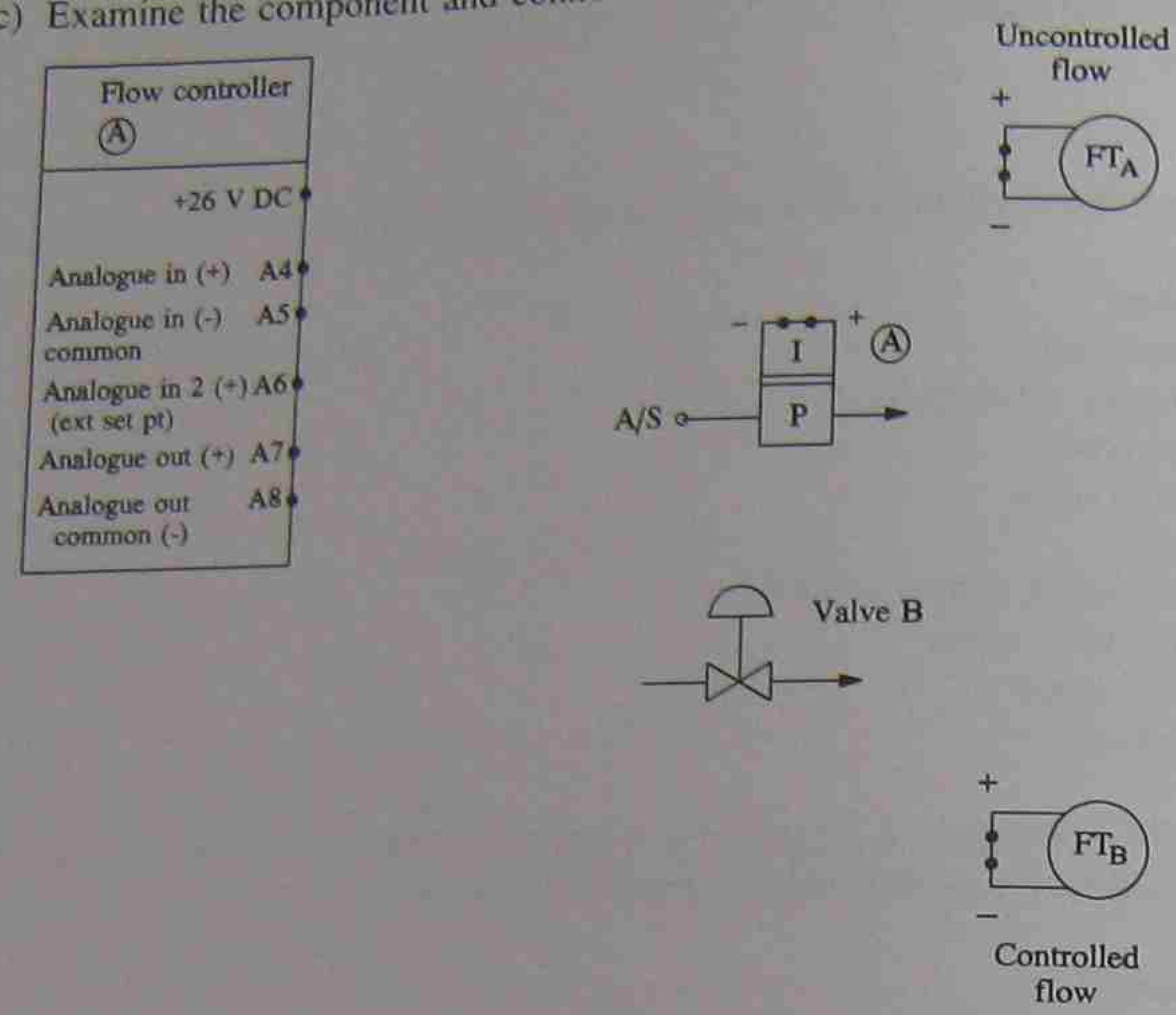


Fig. 2

(d) On the loop diagram label the terminal connection numbers for the instrumentation shown.

2. Draw the connections/terminations on the component and connection diagram, as shown on the loop diagram.

Note: This data will be provided by the teacher, to suit the equipment provided and/or obtainable from instrumentation/data manuals. (A typical example is shown on the adjacent page).

1st try	*2nd try*

3. Connect the components of the control loop, according to the component and connection diagram.

1st try	*2nd try*

Part B Commissioning

1. Start up the plant on manual.

2. Vary the uncontrolled flow and check the operation of the remote set point.

3. Set the ratio to a suitable value and check the operation of the set point.

4. Alter the manual output and check the operation of the transmitter and control valve in the flow control loop.

5. Switch to automatic, vary the uncontrolled flow and check the operation of the controlled flow loop.

Comment briefly on the aspects of this task that you found interesting/important/significant.

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