



Wednesday 14 May 2014 – Morning

**PRINCIPAL LEARNING LEVEL 3
ENGINEERING**

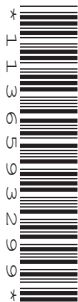
F559/01 Instrumentation and Control Engineering

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
• Scientific calculator

Duration: 2 hours



Candidate forename		Candidate surname	
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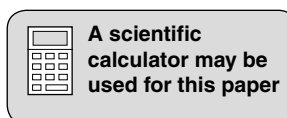
Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions in **Section A** and any **four** questions from **Section B**.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.



2
SECTION A

Answer **all** questions in the spaces provided.

1 Fig. 1 shows a block diagram of a control system.

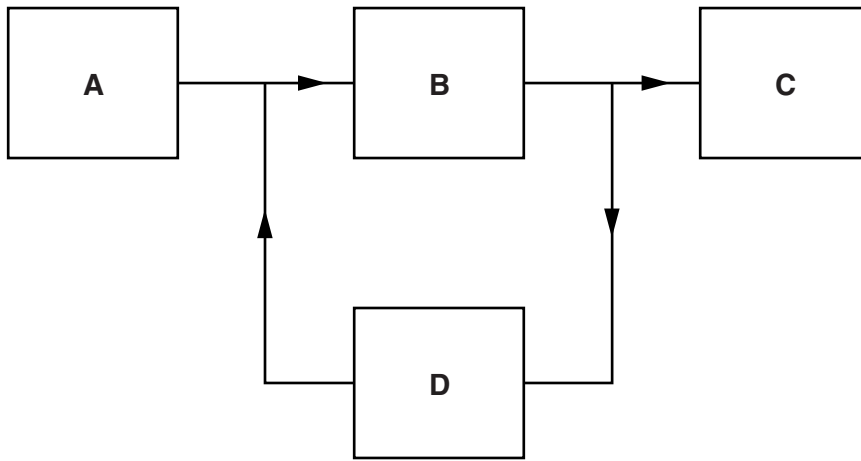


Fig. 1

(a) State which letter is identifying the input.

.....

(b) State which letter is identifying the output.

.....

(c) State which letter is feedback.

.....

[3]

2 State the formula for overall gain in a system using negative feedback.

..... [1]

3 Explain what is meant by the term 'closed loop control' when compared to 'open loop control'.

.....
.....

..... [2]

4 Name an input and an output signal for the following signal conditioners:

(a) Strain gauge

Input

Output

[2]

(b) Potential divider circuit using a potentiometer

Input

Output

[2]

5 State **three** benefits of using electronic instruments to take measurements.

1

2

3

[3]

6 Name an input transducer and state what it reacts to.

.....

.....

[2]

7 Draw the symbol for a shuttle valve in the space below.

[1]

- 8 A pneumatic cylinder has a piston of cross-sectional area 0.02 m^2 . Calculate the working pressure applied to the cylinder when the force exerted by the out-stroking piston is 40 kN.

.....
.....
..... [3]

- 9 State the type of signal processing element used to select one, from a number of analogue signals for further processing.

..... [1]

[Total: 20]

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Section B begins on page 6

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SECTION B

Answer any **four** questions in the spaces provided.

- 1 (a) State **two** practical applications of a thermistor.

1

2

[2]

- (b) Fig. 2 is a graph showing the relationship between resistance and temperature for a thermistor.

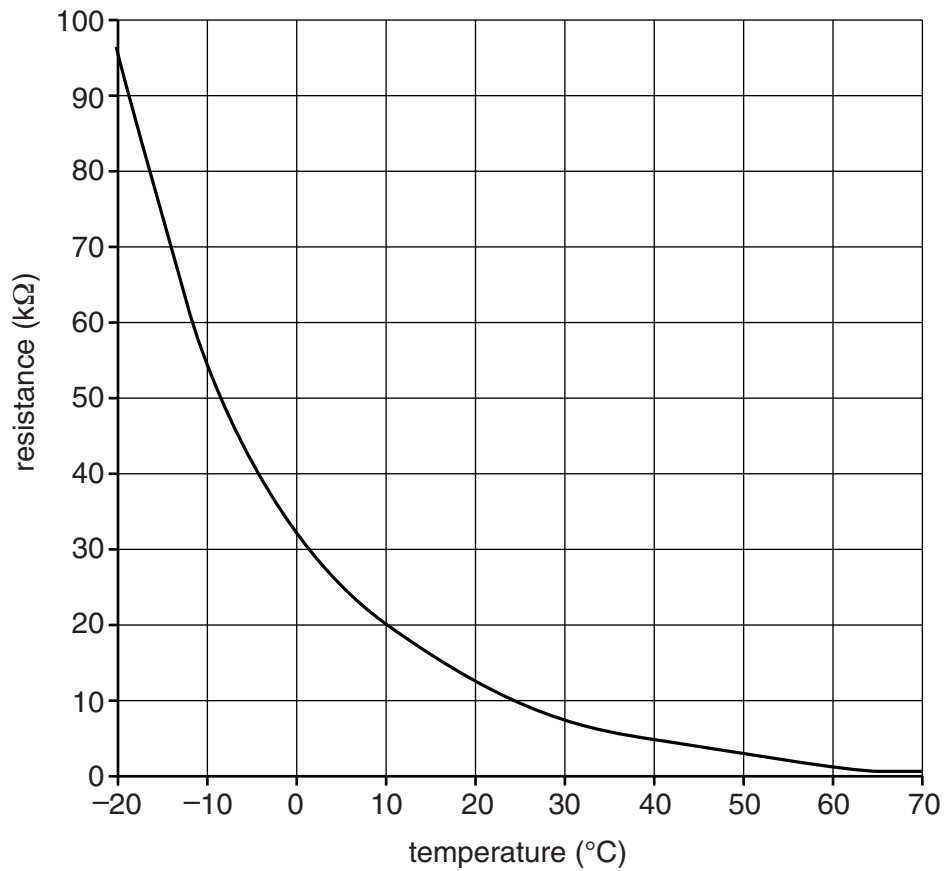


Fig. 2

(i) Determine the thermistor resistance at a temperature of 0°C.

..... [1]

(ii) Determine the temperature at which the thermistor resistance is 10kΩ.

..... [1]

(c) Fig. 3 shows a circuit diagram which includes a thermistor. Describe in detail, how the circuit operates.

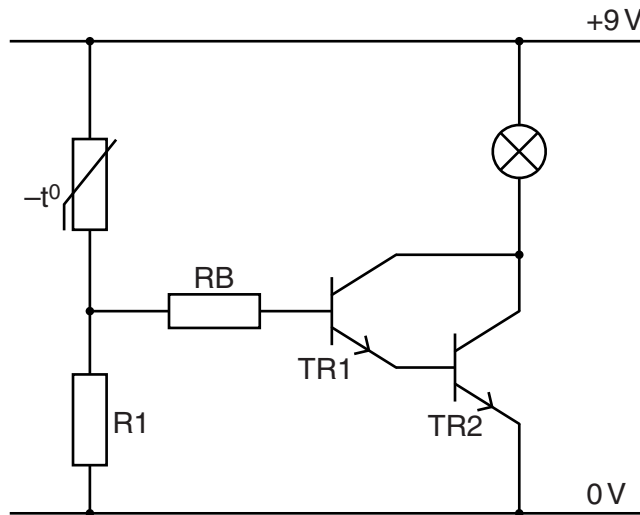


Fig. 3

.....
.....
.....
.....
.....
.....
.....
.....
..... [6]

[Total: 10]

2 (a) Give **two** practical applications of a pneumatic system.

1

2

[2]

(b) Fig. 4 shows a pneumatic circuit.

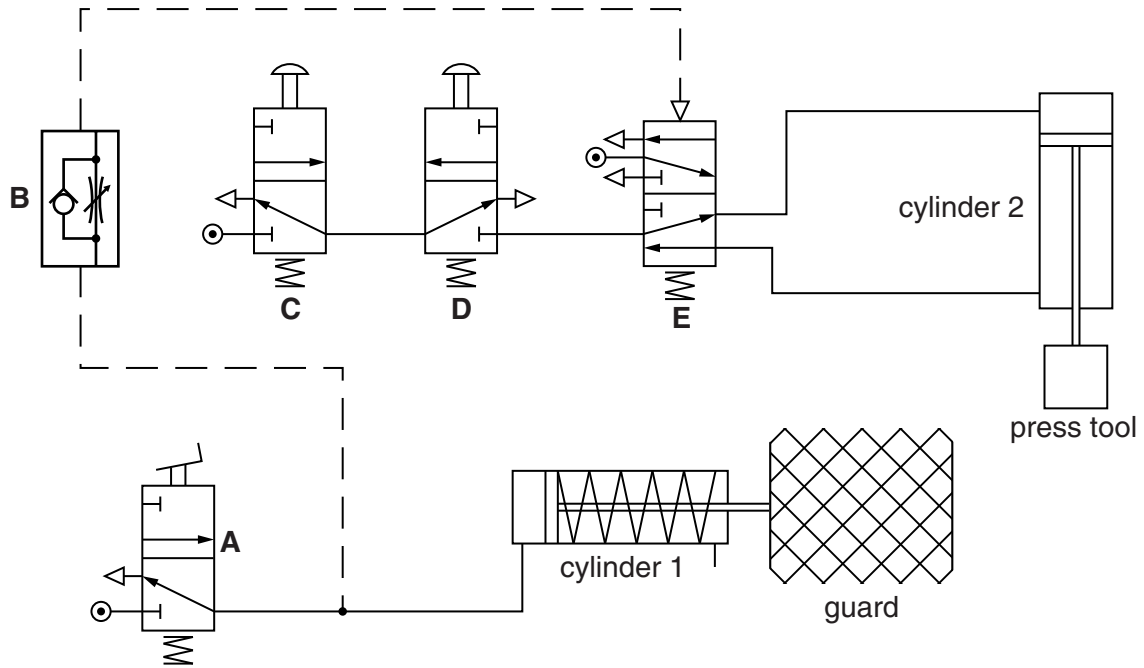


Fig. 4

The 3-port valves (C) and (D) are operated by push buttons.

Give **two** other methods of operating a 3-port valve.

1

2

[2]

3 (a) Name one component that can provide a feedback signal in a control system.

.....
..... [1]

(b) In a negative feedback amplifier the gain is 600.
Calculate the overall gain when the feedback fraction is 1/200.

.....
.....
.....
.....
..... [3]

(c) (i) Draw a circuit diagram of an operational amplifier being used as a buffer amplifier.

[4]

(ii) Draw an input and an output signal for a buffer amplifier.

[2]

[Total: 10]

4 (a) Explain why it is necessary to have a control system monitored.

.....
.....
..... [2]

(b) Give **two** applications of a monitored control system.

1

2 [2]

(c) The following are examples of characteristics of embedded systems within monitoring equipment:

Reliability Maintainability Availability Security Dedicated.

Choose **three** of these examples and explain what is meant by each.

Example 1

.....
.....
.....

Example 2

.....
.....
.....

Example 3

.....
.....
.....

[6]

[Total: 10]

5 Fig. 5 shows the components of a control system.

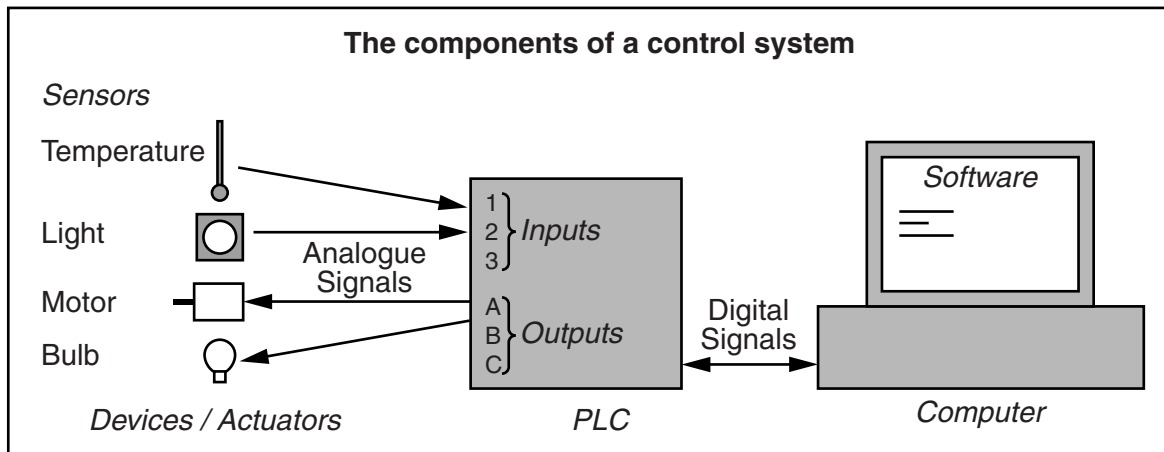


Fig. 5

(a) Give two transducers that could be used for measuring light level in this system.

.....
 [2]

(b) Explain the difference between analogue and digital signals.

.....

 [2]

(c) (i) Explain the reason for having the PLC (Programmable Logic Controller) shown in Fig. 5.

.....

 [4]

(ii) Explain the function of the computer in this system.

.....

.....

..... [2]

[Total: 10]

14
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6 (a) Give **one** benefit of using a PID (proportional-integral-derivative) mode control system as compared to any other type of control system.

.....
.....
..... [1]

(b) Give **three** industrial applications of a PID controller.

1
2
3 [3]

(c) Describe, with the aid of a labelled diagram, the operation of a PID controller.

.....
.....
.....
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.....
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.....
..... [6]

[Total: 10]

7 Fig. 6 shows an electromechanical system for measuring the level of a liquid in a tank.

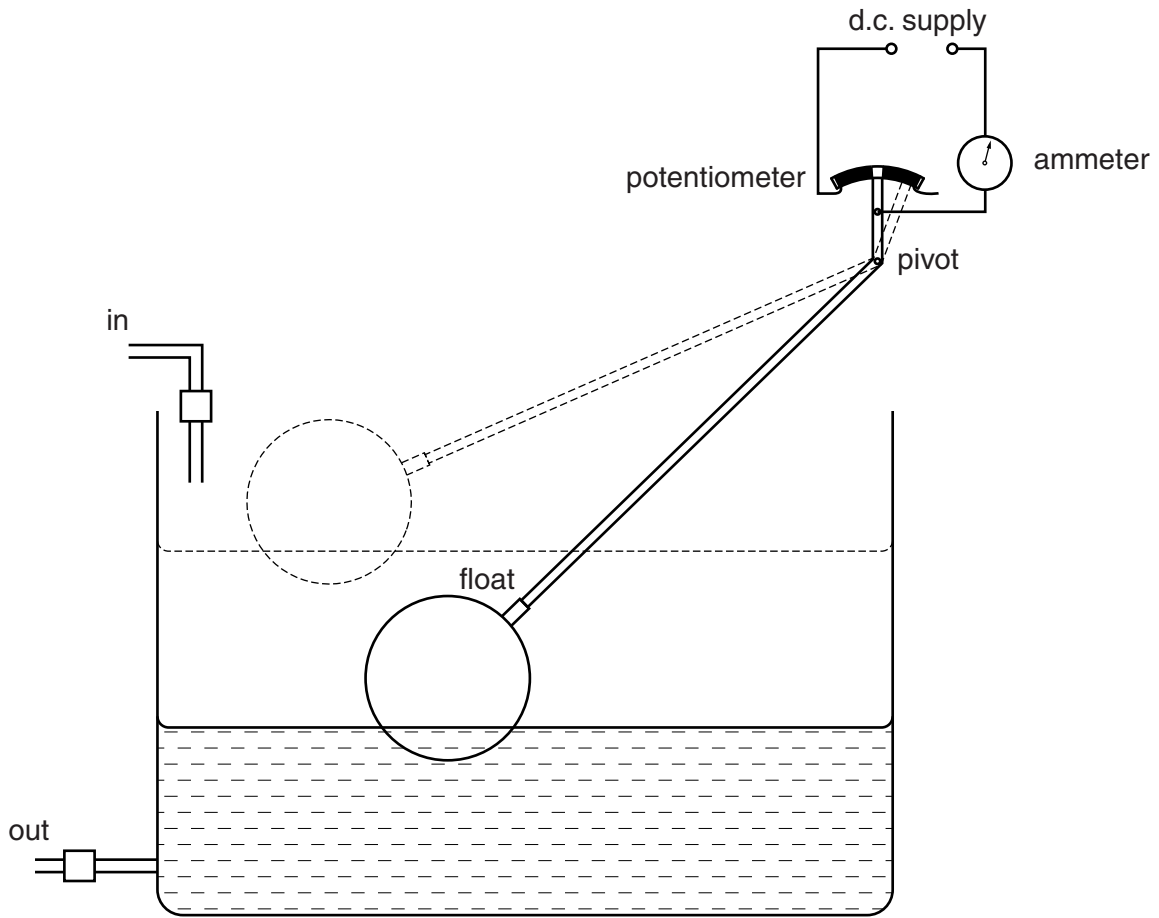


Fig. 6

(a) Explain what is meant by the term 'signal' in the context of a liquid level indicator.

.....

 [2]

(b) Give **two** ways, other than the system shown in Fig. 6, in which the level of liquid in a tank can be measured using electronic instrumentation.

1

 2

[2]

8 (a) One benefit of using simulation software is that physical components are not needed. State **two** other benefits of using simulation software.

- 1
- 2 [2]

(b) Name **two** instruments other than a virtual ammeter and virtual voltmeter that can be used in a simulated test.

- 1
- 2 [2]

(c) Explain how a virtual ammeter and a virtual voltmeter can be used to test simulated electronic circuits.

-
-
-
-
-
-
-
- [6]

[Total: 10]

END OF QUESTION PAPER

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