

12 Pages

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3. The answers must be legibly written. The Examiners can either mark or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
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1	Student Number	2316329
2	Title of Examination Paper	Transducers and Signal Conditioning
3	Module Code	ACDA5006
4	Date and Time of Examination	07/01/25
5	Examination Venue	103
6	Seat Number	031
7	Number of Answer Books handed in	

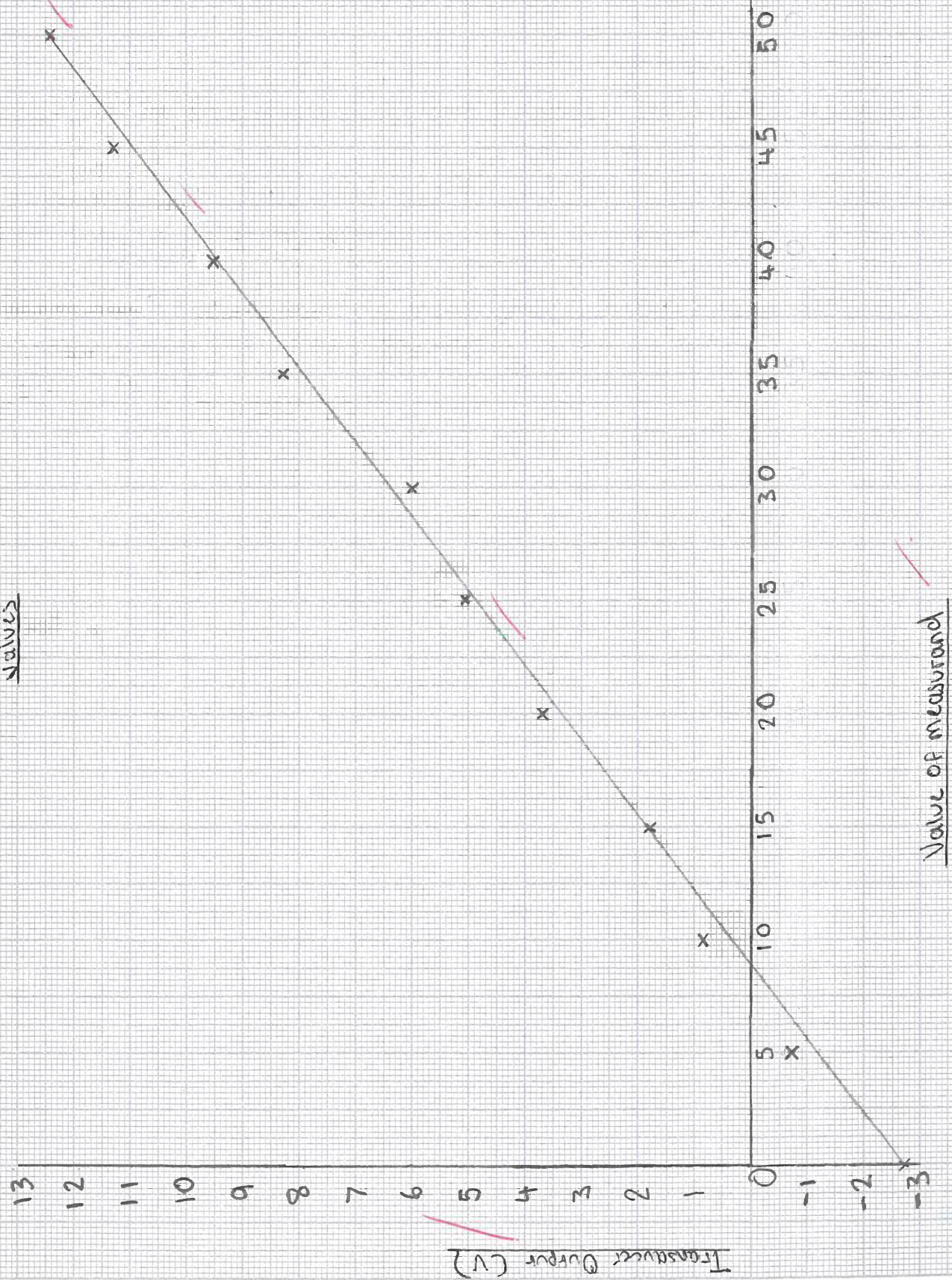
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(Gweler yr ochr arall am y fersiwn Cymraeg)

$$\frac{38}{50} \times 100 = 76\%$$

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A graph to show transducer output (in volts) at different measurand values



① Calibration is the process of comparing an instrument's output readings to that of a second standard instrument to ensure the values conform to the correct values and/or standard

Calibration is needed as through use and over time, the operating characteristics of an instrument / sensor can deviate from the standard values to an unacceptable amount

Calibration will need to occur in the same environment ^{and frequency} the instrument is used in

An instrument whose specifications are known to be correct to standards will be kept solely for calibration purposes

Calibration is needed to ensure measurement outputs stay as ^{close} correct to the correct expected values as possible

100

②

- a) The purpose of this circuit is to provide over voltage protection to protect circuitry from unexpected high voltages ✓
- b) The zener diodes will clamp voltages ~~over the set voltage~~ higher than the set voltage ✓

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The diode D1 is forward biased and can be set to a value e.g. 3.3V ✓

Resistor R1 is used as a buffer ✓

The diode D2 is reverse biased and would have a value of 0.7V ✓

~~This means that any voltages higher than~~

In the case of D1 having a set value of 3.3V and D2 having a value of 0.7V, ~~the~~ any voltages above $(3.3 + 0.7)$ 2.6V would be clipped and conducted to ground. The circuitry after this over voltage protection block would be protected from dangerous voltages and components would not be damaged. ✓

5

(3)

a) Please see graph paper

b) Non linearity is the deviation from a truly linear response

$$\text{Maximum non-linearity} = 5 \quad \frac{5}{50} = 10\% \quad \text{X}$$

$$\text{c) Sensitivity} = \frac{12.41 - (-2.71)}{50 - 0} = \frac{15.12}{50} = 0.3024 \text{ V/V} \quad \checkmark$$

$$\text{d) Zero drift} = \quad 12.41 = -2.71 \times 0.3024 \text{ FC}$$

$$\cancel{12.41} = -2.71 \quad 12.41 = -0.819504 \text{ FC}$$

$$C = 13.229504 \text{ V} \quad \checkmark \quad \text{X}$$

Transducer is a device that converts changes in a physical quantity into an electrical signal or vice versa

$$\cancel{-0.69}$$

(4)

- a) Controlling the amount of chlorine added in a drinking water chlorination plant would require an industrial standard flow level sensor, where it would need to be extremely reliable and accurate. The cost of this sensor would be higher to ensure random errors are prevented to the highest possibility as errors with this sensor could cause fatalities and illnesses, as there could be dangerous chemicals ^{left} ~~contamin~~ to contaminate the drinking water. This flow sensor would need to be appropriate to measure liquids. This flow sensor would be larger and able to withstand harsh conditions.
- b) The flow sensor would need to be appropriate to measure gases and would be ~~less~~ less expensive than the chlorination plant. It could also be smaller as it is handling the output of just one household. It doesn't have to be extremely accurate as it is providing an estimate of gas use to the customer.

The
Key specifications of a flow sensor would be cost, reliability, type of use

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⑤ Random errors are errors that do not have an easily findable source, which makes them difficult to prevent and remove

Systematic errors are errors that occur from shortcomings in the instrument such as sensitivity drift. They can also occur from loading of the instrument. Systematic errors can be removed through calibration and maintenance

5

✓

⑥ Accuracy is the degree to which the output readings of a measurement conform to the correct values and specification. // //

Precision is an instrument's degree of freedom from random errors. /

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