higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 3

(6060463)

7 November 2018 (X-Paper)
09:00–12:00

This question paper consists of 5 pages and 1 formula sheet.

NCV

TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. ALL drawings must be neat and in good proportion.
5. Start each section on a NEW page.
6. Write neatly and legibly.

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QUESTION 1

1.1 Choose a word or words from COLUMN B that match a description in COLUMN A. Write only the letter (A–G) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1.1	Device that converts the signal produced by a sensor to a standardised instrumentation signal	A	electronic transmitter
1.1.2	Can either be analogue or digital	B	disadvantage of flapper and nozzle system
1.1.3	Used to vary pressure of output signal which is proportional to the measured variable	C	advantage of flapper and nozzle system
1.1.4	Used when electrical supply is not present	D	provides a greater volume of air
1.1.5	Sensitive to vibration	E	pneumatic transmission
		F	flapper and nozzle system
		G	transmitter

(5 × 1) (5)

1.2 Give SIX problems associated with pneumatic transmission. (6)

1.3 Name FOUR disadvantages of a pneumatic system. (4)

1.4 Make a neat, labelled diagram of a force-balance pneumatic system. (8)

[23]

QUESTION 2

2.1 State TWO principles used for the construction of a radiation pyrometer.

(2 × 2) (4)

2.2 2.2.1 What is a *black body*? (2)

2.2.2 Make a neat drawing to illustrate black-body radiation. (4)

2.2.3 Explain the *black-body condition*. (4)

2.2.4 State FIVE advantages of a radiation pyrometer. (5)

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2.2.5 Make a neat, labelled sketch of a total radiation (mirror type) pyrometer. (8)

2.2.6 Explain how the instrument in QUESTION 2.2.5 works. (5)

2.2.7 Explain how you will calibrate this instrument. (5)

[37]

QUESTION 3

3.1 Name FIVE structures that represent open-channel flow. (5)

3.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (3.2.1–3.2.5) in the ANSWER BOOK.

3.2.1 Ultrasonic-level measurement is a non-contact method of measuring liquids and solids.

3.2.2 Ultrasonic-level measuring equipment is accurate, reliable and low-maintenance devices.

3.2.3 When installing ultrasonic transducers, the beam deflection angle must be taken into consideration.

3.2.4 Open channels are natural and man-made structures with a free surface through which water flows.

3.2.5 Device fabrication is an error made by a designer and can cause an instrument not to work properly.

(5 × 1) (5)

3.3 3.3.1 Why must the transducer be mounted perpendicular to the surface of the material to be measured?

3.3.2 Why must the height at which the transducer is mounted above the tank be such that the maximum level in the vessel falls within the operating range of the transducer?

3.3.3 Why is the beam deflection angle important?

(3 × 2) (6)

3.4 Flowmeters are divided into two groups.

3.4.1 Name the two groups. (2)

3.4.2 Explain each group. (4 × 2) (8)

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3.5 List FIVE errors in the equipment of open-channel flow measurement that can be caused by operators, designers or installers and which could have been avoided. (5)

3.6 Explain how you will go about doing each of the following:

3.6.1 Flowmeter calibration (6)

3.5.2 Maintenance activities (8)

[45]

QUESTION 4

4.1 If a solution is added with S.G. = 1,28 bringing the level in a flask up to 12 cm what will the gauge read? Answer in millibar. (10)

4.2 Capacity probes have been used in factories and in the mining industry for many years. They are also suitable for measuring the level of both solids and liquids.

4.2.1 Give a general description of a capacitance probe. (6)

4.2.2 On what principle is the capacitance level probe based? (4)

4.3 Explain the importance of a measuring level. (3)

4.4 To what height will the mercury in a U-tube manometer rise above the zero mark if the level in the water tank is 7,5 m? The zero level of the manometer is in line with the zero level of the tank. (8)

4.5 Generally there are two methods used in industry for the measuring of liquids.

4.5.1 Name the TWO methods. (2)

4.5.2 Distinguish the difference between the two methods named in QUESTION 4.5.1. (4)

4.6 4.6.1 Make a neat sketch of a conductance-type meter that uses manometers. (6)

4.6.2 Where will the increase or decrease of resistance be detected on the sketch in QUESTION 4.6.1 when the level rises or falls? (2)

[45]

TOTAL: 150

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INSTRUMENT TECHNOLOGY L3

FORMULA SHEET

$P_G = P_{abs} - Pa$

$P_1 - P_2 = h\rho g$

$P_1 - P_2 = d\rho g \left(\frac{A1}{A2} + 1\right)$ or $P_1 - P_2 = d\rho g \left(\frac{A2}{A1} + 1\right)$

$P = \frac{Mg}{A}$

$\frac{Q1}{Q2} = \frac{k\sqrt{h1}}{k\sqrt{h2}}$

Dry calibration = $\frac{P1-P2}{\rho g}$

Wet calibration = $\frac{P1-P2}{(\rho 2 - \rho 1)g}$

W.C. = $\left(\frac{P1-P2}{(\rho 2 - \rho 1)}\right)$ X D.C

D.C. = $\left(\frac{P1-P2}{\rho 2}\right)$ X W.C.

H = $\frac{\Delta P}{\rho g}$

H = h $\frac{\rho 2}{\rho 1}$

t^o = 9/5 t + 32° F

t^o C = (t + 273,15) K

t^o F = 5/9 (t – 32)^o C

P = h x d x g

HL = (pm/pL x h) – h/2

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