higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N2

(11040452)

20 November 2020 (X-paper)
09:00–12:00

This question paper consists of 7 pages and 1 formula sheet.

185Q1E2020

Copyright reserved

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INSTRUMENT TRADE THEORY N2
TIME: 3 HOURS
MARKS: 100

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. Start each section on a new page.
5. Use only a black or blue pen.
6. Write neatly and legibly.

Copyright reserved

SECTION A

QUESTION 1

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 A flexible disc, usually with concentric corrugations, which is held fixed around its periphery, allowing the centre of the disc to deflect.

A Diaphragm stack
B Bellows
C Slack diaphragm
D Capsule

1.2 The … of the fluid is the difference between the pressure of the fluid and the absolute zero of pressure.

A gauge pressure
B vacuum pressure
C total pressure
D differential pressure

1.3 Which of the following meters use the principle of Faraday's law of electromagnetic induction?

A Turbine flow meter.
B Vortex flow meter.
C Magnetic flow meter.
D Deflecting-type flow meter.

1.4 An irregular movement of fluid, made up of many smaller currents, swirling and moving in all directions.

A Turbulent flow.
B Laminar flow.
C Ideal flow.
D Transitional flow.

1.5 A multi-pitot tube with more than one hole at different levels and directions drilled into one tube, so that more than one pressure for the same flow velocity can be measured:

A Pitot tube
B Flow nozzle
C Annubar
D Orifice plate

(5 × 1) **[5]**

Copyright reserved

QUESTION 2

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1–2.5) in the ANSWER BOOK.

2.1 The calibration of a ring balance meter is affected by density variations resulting from temperature changes.

2.2 A dry gas meter has four measuring chambers since there are two impellers.

2.3 Type T-thermocouples consists of copper and constantan wires.

2.4 The lead wire resistance added to the thermometer resistance in a two-lead method gives a false temperature reading.

2.5 Gravity provides the controlling force in a single bell thin wall.

(5 × 1) **[5]**

QUESTION 3

Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–L) next to the question number (3.1–3.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1	The difference between the value indicated and the value obtained from a reliable instrument	A	wet gas meter
3.2	The measuring chambers for this meter are sealed off with water or any other liquids, that fills the outside chamber just above the centre line	B	upper fixed point
3.3	These thermometers indicate temperature by means of the change in volume or pressure of the liquids or gas inside them.	C	gas purge systems
3.4	It consists of a supply of air or other suitable gas forced down through a vertical pipe just above the bottom of the tank	D	thermopile
3.5	The temperature of steam from water boiling at one standard atmosphere	E	hysteresis effect
3.6	A metal or wooden bar with a scale marked on its side	F	thermocouple
3.7	An electrical temperature sensor made of two dissimilar metal wires	G	volumetric type flow meters
3.8	Measurement devices that close off a known volume of liquid into compartments and allow it to pass from the inlet to the outlet	H	expansion thermometer
3.9	A collection of similar thermocouples connected in series	I	magnetic flow meter
3.10	The resistance of a liquid to flow	J	turbine flow meter
		K	viscosity
		L	dipstick

(10 × 1) **[10]**

TOTAL SECTION A: 20

SECTION B

QUESTION 4: PRESSURE MEASUREMENT

4.1 Explain Boyle's law as applicable to the McLeod vacuum gauge. (2)

4.2 Briefly explain the principle of operation of a dead-weight tester. (6)

4.3 Calculate the height of the mercury of a manometer.

4.3.1 Calculate the length of the scale of a mercury-filled manometer when a differential pressure of 10 KPa is applied to it under dry conditions. (3)

4.3.2 Now calculate the length of the scale if the same manometer is used to measure water flow with the same differential pressure of 10 KPa (3)

4.3.3 What conclusion can you draw from your answers to questions 4.3.1 and 4.3.2? (2)

4.4 Calculate the distance on the scale of an inclined-tube manometer filled with mercury. The applied pressure difference is 20 KPa and the tube is at a 35° angle to horizontal. The area of the well is 115 mm² and the tube is 20 mm² (4)

[20]

QUESTION 5: TEMPERATURE MEASUREMENT

5.1 Explain the Seebeck effect. (3)

5.2 Name THREE metals used to manufacture resistance thermometers. (3)

5.3 Make a neat labelled sketch of a self-balancing potentiometer circuit. (10)

5.4 Name FOUR types of expansion thermometers. (4)

[20]

QUESTION 6: FLOW MEASUREMENT

6.1 Draw a neat, graphical representation of the velocity and pressure distribution through an orifice. (5)

6.2 A gas flow meter has a maximum flow range of 1000 m³/h at a differential pressure of 500 mm WC.

Calculate the new differential pressure if the flow range is changed to a maximum reading of 2000 m³/h. (5)

Copyright reserved

6.3 Draw a neat, graphical representation illustrating the difference between the scaling of an orifice plate and a variable area type flow meter. (5)

6.4 Make a simple, neat sketch to show how the following measuring impulse points can be installed on an orifice plate installation:

- Corner taps
- Flange taps
- Radius taps
- Pipe taps
- Vena contracta taps (5)

[20]

QUESTION 7: LEVEL MEASUREMENT

7.1 Calculate the height of water in an open tank with the aid of a mercury manometer if the following applies:

The zero mark of the manometer is 0,5 m below the zero level of the tank.
The mercury is displaced 0,1 m from the zero mark in the manometer. (5)

7.2 Make a neat, labelled sketch of the operating parts of a buoyancy type torque tube displacer unit as used for level indication. (4)

7.3 Explain the operation of the level device mentioned in QUESTION 7.2. (5)

7.4 Complete the following table.

	Operation	Output – 0%	Output – 100%
Pneumatic D/P cell	(7.4.1) …	(7.4.2) …	(7.4.3) …
Electronic D/P cell	(7.4.4) …	(7.4.5) …	(7.4.6) …

(6)

[20]

TOTAL SECTION B: 80
TOTAL: 100

Copyright reserved

INSTRUMENT TRADE THEORY N2

FORMULA SHEET

(1) $\Delta P = \rho g h$

(2) $\Delta P = \rho g h \left[\frac{A_2}{A_1} + 1\right]$

(3) $\Delta P = \rho g L \left[\sin\theta + \frac{A_2}{A_1}\right]$

(4) $P_1 - P_2 = \frac{r_2 M g \sin\theta}{A r_1}$

(5) $P_1 - P_2 = \frac{M g r \sin\theta}{A L}$

(6) $F = ma$

(7) $P = \frac{F}{A}$

(8) $A = \frac{\pi d^2}{4}$

(9) $°F = \frac{9}{5}\,°C + 32$

(10) $R_T = R_0(1 + \propto T)$

(11) $R_T = R_0(1 + \propto T + \beta T^2)$

(12) $Q = k\sqrt{h}$

(13) $H_L = \left[\frac{\rho_m}{\rho_L}\right] \times h - \frac{h}{2}$

(14) $H_L = \left[\frac{\rho_m}{\rho_L}\right] \times h - H_1 - \frac{h}{2}$

Copyright reserved