higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N2

(11040452)

1 August 2018 (X-Paper)
09:00–12:00

This question paper consists of 6 pages and 1 formula sheet

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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. Sketches must be large, neat and fully labelled.
5. Write neatly and legibly.

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SECTION A

QUESTION 1

1.1 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 (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.4 Which ONE of the following is NOT an example of a positive displacement flowmeter?

A Magnetic flowmeter
B Oscillating piston flowmeter
C Sliding vane flowmeter
D Reciprocating flowmeter

1.1.2 Which ONE of the following is an example of a direct level measurement device?

A Gas-purging level detector
B Sight-glass level meter
C Capacitive level meter
D Ultrasonic level meter

1.1.3 Which ONE of the following thermometers has no need for ambient temperature compensation?

A Vapour-pressure expansion thermometer
B Bimetallic expansion thermometer
C Liquid expansion thermometer
D Gas expansion thermometer

1.1.4 Irregular flow movement of a 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

1.1.5 Indication error over the full range of the instrument:

A Angularity error
B Span error
C Zero error
D Hysteresis error

(5 × 1) (5)

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1.2 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–N) next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.2.1	Point where the flow tempo is at its highest and the pressure at its lowest after an orifice plate	A	specific gravity
1.2.2	This error is caused by insensitivity in the low range	B	laminar flow
1.2.3	Two wires of different materials joined together, emf is generated in the circuit if one junction is heated and the other is kept at constant temperature	C	Boyle's law
1.2.4	The number of times the mass of any volume of a substance is greater (or smaller) than the mass of the same volume of water under identical conditions	D	peltier effect
1.2.5	The low flow velocities characterised by the individual fluid particles travelling in a straight path	E	zero error
1.2.6	Temperature of steam from water boiling at one standard atmosphere	F	law of homogeneous metals
1.2.7	The volume of any mass of gas is inversely proportional to the absolute pressure, if the temperature stays constant	G	positive displacement flowmeter
1.2.8	Type of a manometer which is best for measuring low pressures	H	Seebeck effect
1.2.9	The meter operates by trapping a known volume of fluid and counting the number of trapped volumes	I	magnetic flowmeter
1.2.10	An electric current cannot be sustained in a single homogeneous metal by means of heat alone	J	vena contracta
		K	range error
		L	inclined tube manometer
		M	upper fixed point
		N	law of intermediate temperatures

(10 × 1) (10)

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1.3 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

1.3.1 A dipstick is an example of a direct level measuring instrument.

1.3.2 The calibration of the ring balance meter is affected by density variations that might result from temperature changes.

1.3.3 An inclined tube manometer is used to measure low pressure.

1.3.4 All Bernoulli-type primary flow elements set up a differential pressure which varies as a square root of the flow rate.

1.3.5 The magnetic flow meter can only measure conductive fluids.

(5 × 1) (5)
[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2: PRESSURE MEASUREMENT

2.1 Name and explain the TWO errors that occur in manometers. (5)

2.2 Make a neat, labelled sketch of dead-weight tester. (6)

2.3 Calculate the pressure that must be indicated on a pressure gauge if a mass of 20 kg is placed on the platform of a dead-mass tester having an area of 0,1 m^2. (3)

2.4 Explain the difference between *dry calibration* and *wet calibration*. (2 × 2) (4)

2.5 Define each of the following :

2.5.1 Differential pressure

2.5.2 Gauge pressure

(2 × 1) (2)
[20]

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QUESTION 3: TEMPERATURE MEASUREMENT

3.1 Make a neat, labeled sketch of a thermocouple. (5)

3.2 Name the TWO groups in which thermocouples fall. (2)

3.3 Make a neat, labelled sketch of a helical bimetal expansion thermometer. (7)

3.4 Name the TWO compensating methods used in the Wheatstone bridge circuit in order to eliminate errors. (2)

3.5 Name TWO disadvantages of the two-lead wire method in an unbalanced Wheatstone bridge circuit (2 × 2) (4)

[20]

QUESTION 4: FLOW MEASUREMENT

4.1 Explain the working principle of rate or inferential-type flowmeters. (3)

4.2 Make a neat, labelled sketch of a variable area flowmeter. (5)

4.3 If the maximum flow rate of 500 ℓ/h and the differential pressure of 16 KPa are registered across a restriction, what would the differential pressure be if the flow rate is decreased to half? (3)

4.4 Sketch and explain the operation of a deflecting vane-type liquid flow meter. (9)

[20]

QUESTION 5: LEVEL MEASUREMENT

5.1 Name the FIVE groups into which level measuring instruments can be divided. (5)

5.2 The back pressure of a purge level system is 37 KPa and the liquid density is 800 kg/m^3.

Calculate the depth of the purge point of the tube below the surface of the liquid. (4)

5.3 Name TWO types of differential pressure cells. (2)

5.4 Make a neat, labelled sketch of a conduction level method and briefly explain its working principle. (9)

[20]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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INSTRUMENT TRADE THEORY N2

FORMULA SHEET

(1) $$\Delta P = \rho gh$$

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

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

(4) $$P_1 - P_2 = \frac{r_2 Mg\sin\theta}{Ar_1}$$

(5) $$P_1 - P_2 = \frac{Mgr\sin\theta}{AL}$$

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

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