higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N2

(11040452)

24 November 2022 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 4 pages and 1 formula sheet.

207Q1E2224

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. Take g = 10 m/s².
5. Use only a black or blue pen.
6. Write neatly and legibly.

QUESTION 1

1.1 Make a neat, labelled sketch of a single-bell thick wall pressure instrument and briefly explain its operation. (7)

1.2 Name FOUR metals used to make Bourdon tubes. (4)

1.3 List FIVE factors that will influence the free-end movement of a Bourdon tube. (5)

1.4 Draw a neat, labelled sketch of differential pressure measurement. (4)

1.5 A dead-weight tester contains a piston with a diameter of 30 mm.

Calculate the mass that must be placed on the platform to calibrate the pressure gauge at 120 kPa. (5)

[25]

QUESTION 2

2.1 What is meant by the *fundamental interval* of a resistance thermometer? (3)

2.2 Make a neat, labelled circuit of a DC-to-AC transducer (vibrating reed). (5)

2.3 Make a neat, labelled sketch of a typical Wheatstone bridge. (5)

2.4 Give TWO disadvantages of an unbalanced bridge. (2)

2.5 Name FIVE errors in temperature measurement due to thermocouples. (5)

2.6 Complete the table below by writing only the answer next to the question number (2.6.1–2.6.5) in the ANSWER BOOK.

	Celsius	**Kelvin**	**Fahrenheit**
Melting point of ice	2.6.1	2.6.2	32 °F
2.6.3	100 °C	2.6.4	2.6.5

(5 × 1) (5)

[25]

QUESTION 3

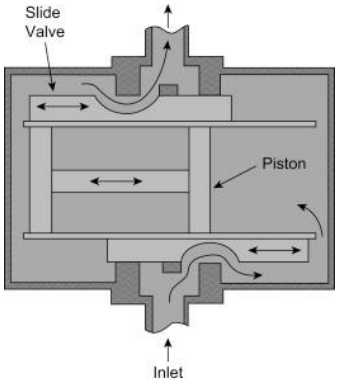
3.1 Name THREE types of orifice plates. (3)

3.2 Draw the THREE types of orifice plates named in QUESTION 3.1. (3 × 2) (6)

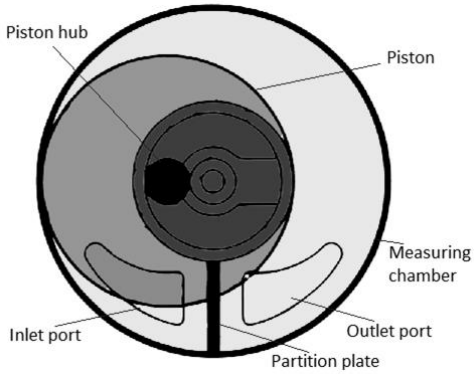
3.3 Explain the operating principle of a pitot-tube flowmeter. (6)

3.4 Name each of the following positive-displacement meters:

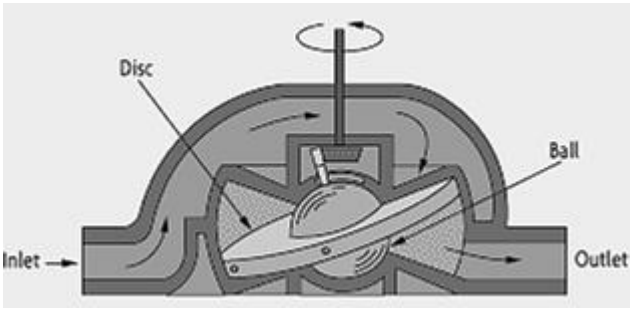
3.4.1



3.4.2



3.4.3



(3 × 2) (6)

3.5 A rectangular vane is hung in a stream of liquid. The top end is fixed to a pivot.

Name any TWO forces acting on the vane. (2 × 2) (4)

[25]

QUESTION 4

4.1 Draw a sight-glass level meter and explain its operation. (10)

4.2 Sketch and explain the operation of a float and counterweight type level meter. (10)

4.3 Make a neat, labelled sketch of a capacitance level meter. (5)

[25]

TOTAL: 100

(11040452)

FORMULA SHEET

$P_G = P_{abs} - Pa$

$P_1 - P_2 = h\rho g$

$P_1 - P_2 = d\rho g \left(\frac{A_1}{A_2} + 1\right) \quad \textbf{OR} \quad P_1 - P_2 = d\rho g \left(\frac{A_2}{A_1} + 1\right)$

$$p = \frac{mg}{A}$$

$$\frac{Q_1}{Q_2} = \frac{k\sqrt{h_1}}{k\sqrt{h_2}}$$

Dry calibration $= \frac{P_1 - P_2}{\rho g}$

Wet calibration $= \frac{P_1 - P_2}{(\rho_2 - \rho_1)g}$

$$WC = \left(\frac{\rho_2}{\rho_2 - \rho_1}\right) \times DC$$

$$DC = \left(\frac{\rho_2 - \rho_1}{\rho_2}\right) \times WC$$

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

$$H = h\left(\frac{\rho_2}{\rho_1} - \frac{1}{2}\right)$$

$$H = \frac{\rho_2}{\rho_1}h - \frac{h}{2} - H = \left(\frac{\rho_2}{\rho_1} - \frac{1}{2}\right)h - H_1$$

$$A = \frac{\pi D^2}{4}$$

$$t\,°C = \frac{9}{5}t + 32\,°F$$

$$t\,°C = (t + 273{,}15)\,K$$

$$t\,°F = \frac{5}{9}(t - 32)\,°C$$