higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 2

(6060452)

27 February 2020 (Y-paper)
13:00–16:00

This question paper consists of 7 pages.

115Q1S2027

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

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QUESTION 1

1.1 Explain each of the following acronyms:

1.1.1 SIL

1.1.2 SIF

1.1.3 SIS

(3 × 2) (6)

1.2 The testing instruments below are used to measure and test systems to make sure it is working properly.



INSTRUMENT A



INSTRUMENT B

1.2.1 When is Instrument A used?

1.2.2 When is Instrument B used?

(2 × 3) (6)

1.3 List THREE common signal methods used to transfer information. (3)

[15]

QUESTION 2

2.1 Give THREE advantages of each of the following actuators:

2.1.1 Spring-and-diaphragm actuator

2.1.2 Piston actuator

2.1.3 Balanced actuator

(3 × 3) (9)

2.2 Make a neat, labelled sketch of a single-acting spring-and-diaphragm actuator. (10)

2.3 Name FIVE systems or pieces of equipment where limit switches are used. (5)

2.4 2.4.1 List FIVE common problems associated with positioners. (5)

2.4.2 Explain how to generally maintain a positioner. (6)

2.5 Which problems can be experienced with a fail-safe system? (2)

[37]

QUESTION 3

3.1 3.1.1 Give the THREE laws that explain the principle of pressure measurement. (3)

3.1.2 Explain each law given in QUESTION 3.1.1. (3 × 3) (9)

3.1.3 Write the formulae for each law given in QUESTION 3.1.1. (3)

3.2 A person weighs 80 kg and is standing still on an even floor.

3.2.1 Calculate the force of the person's body working on the floor. (2)

3.2.2 Calculate the pressure the person exerts on the floor as a result of standing on the floor area of 0,025 m^2. (3)

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3.3 Choose an item from COLUMN B that matches an item in COLUMN A. Write only the letter (A–J) next to the question number (3.3.1–3.3.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.3.1	Drain the fluid	A	component of a Bourdon tube
3.3.2	Menisci	B	rarely used for measurements in plants
3.3.3	Indicating needle	C	used to calibrate pressure instruments
3.3.4	Static pressure	D	Pv = RT
3.3.5	Errors in direct-reading manometers	E	curved lines where the surface of a liquid and air meet
3.3.6	Inclined-tube manometer	F	widely used in the measurement of pressure, liquid level and rate of flow
3.3.7	Equal-leg manometer	G	measures low pressure or differential pressure very accurately
3.3.8	Ideal-gas equation	H	guidelines for cleaning manometers
3.3.9	Bourdon tube	I	capillary effect and parallax effect
3.3.10	Dead-weight tester	J	pressure gauges

(10 × 1) (10)
[30]

QUESTION 4

4.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (4.1.1-4.1.5) in the ANSWER BOOK.

4.1.1 Galileo Galilei invented the first thermometer.

4.1.2 Jean Ray invented the first liquid thermometer.

4.1.3 In the 1900s there were many developments in temperature measurements.

4.1.4 Semiconductor equipment was discovered in the 1800s.

4.1.5 Seebeck realised in 1821 that he could create a current if he heated two junctions of different metals unequally.

(5 × 1) (5)

4.2 4.2.1 Give THREE examples of areas or systems where RTDs can be used. (3)

4.2.2 Explain THREE limitations to consider when using RTDs. (3)

4.2.3 Which materials are used when constructing RTDs? (3)

4.2.4 Make a drawing of wire-wound platinum RTD. (5)

4.2.5 How is an RTD installed? (4 × 2) (8)

4.2.6 How is an RTD commissioned? (3)

[30]

QUESTION 5

5.1

NORMAL PIPE SIZE	OD	SCHEDULE 20		SCHEDULE 40		SCHEDULE 80	
		Wall	kg/m	Wall	kg/m	Wall	kg/m
½	21,3			2,77	1,27	3,73	1,62
¾	26,7			2,87	1,69	3,91	2,2
1	33,4			3,38	2,5	4,55	3,24
11/4	42,2			3,56	3,39	4,85	4,47
11/2	48,3			3,68	4,05	5,08	5,41
2	60,3			3,91	5,44	5,54	7,48
21/2	73			5,16	8,63	7,01	11,41
3	88,9			5,49	11,29	7,62	15,27
31/2	101,6			5,74	13,57	8,08	18,63
4	114,3			6,02	16,07	8,56	22,32
5	141,3			6,55	21,77	9,53	30,97
6	168,3			7,11	28,26	10,97	42,56
8	219,1	6,35	33,31	8,18	42,55	12,7	64,64
10	273,1	6,35	41,77	9,27	60,31	15,09	96,01
12	323,9	6,35	49,73	10,31	79,73	17,48	132,08

5.1.1 When a pipe scheduled at 20 is recommended for a flow of 3 m^3/s, what would the permissible speed (m/s) for a steel pipe with an outside diameter of 457 be? (8)

5.1.2 Calculate the flow rate of water that a pipe will have if it has the following characteristics:

- OD: 73 mm
- Speed: 3 m/s
- Material: Steel
- Pipe schedule: 40

(8)

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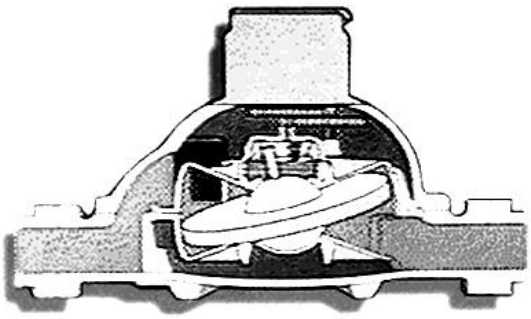
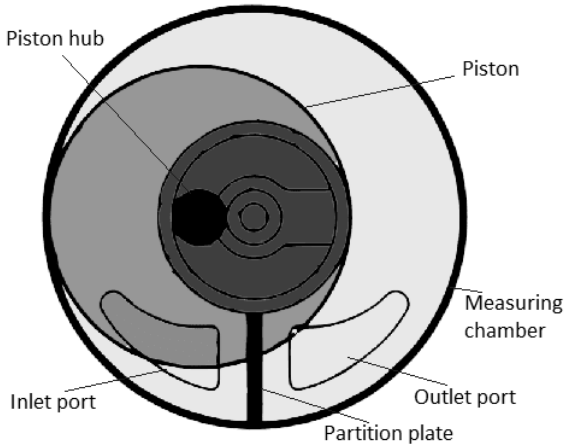
5.2



PICTURE A



PICTURE B



PICTURE C

5.2.1 Label the flowmeters shown in Picture A, Picture B and Picture C. (3 × 2) (6)

5.2.2 What is the purpose of these flowmeters? (4)

5.2.3 Give FIVE applications of these flowmeters. (5)

5.2.4 Give FIVE disadvantages of these flowmeters. (5)

5.2.5 Name the TWO parts that are common in all these flowmeters. (2)

[38]

TOTAL: 150

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