higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL INSTRUMENTS N6

31 March 2020

This marking guideline consists of 7 pages.

SECTION A

QUESTION 1

1.1 Paramagnetic
1.2 Cascade
1.3 Division
1.4 Continuous spectrum
1.5 Two-element

(5 × 1) **[5]**

QUESTION 2

2.1 Valve characteristic
2.2 Flashing
2.3 Spectrum
2.4 Continuous spectrum
2.5 Class III

(5 × 1) **[5]**

QUESTION 3

3.1 The National Electrical Code defines intrinsically safe equipment and wiring as incapable of realising sufficient electrical or thermal energy✓ under normal or abnormal conditions✓ to cause ignition of specific hazardous atmosphere mixtures.✓ (3)

3.2 A process of separating a mixture of two or more substances into their individual components✓ by heating the mixture until the more volatile component passes into the vapour phase✓ and then cooling the vapour to recover such component in liquid form by condensation.✓ (3)

3.3
- An analyser is a device that examines in detail the structure of the given data and tries to find patterns and relationships between parts of the data.
- An analyser can also be an instrument or device which conducts chemical analysis (or similar analysis) on samples or sample streams. (Any 1 × 2) (2)

3.4 Boilers are devices that are used to heat water for the generation of steam and hot water✓ in industrial processing plants where steam demands vary according to the requirements.✓ (2)

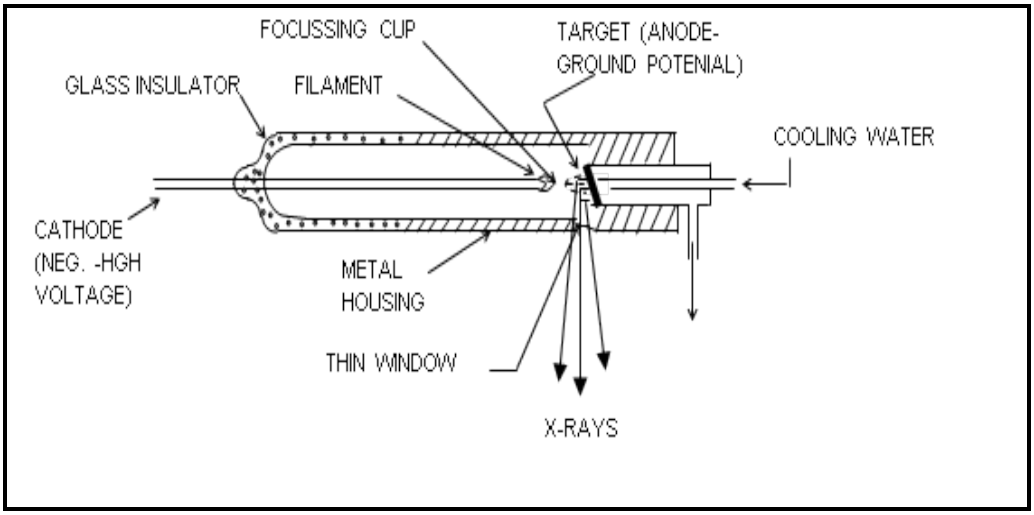
[10]

TOTAL SECTION A: 20

SECTION B

QUESTION 4

4.1 4.1.1



(9)

4.1.2 In a high-vacuum Coolidge-type tube, electrons are emitted from a heated tungsten filament and accelerated by a high voltage to an anode (target). The process emits the X-rays when the electrons strike the target, i.e. X-rays are emitted by atoms, which are bombarded with energetic electrons due to:

- Deceleration of high-speed electrons as they pass through matter, and/or
- Ionisation of individual atoms that abruptly stop the electrons (4)

4.2 4.2.1 Mass spectrometer analyser (2)

4.2.2 A – Sample inlet system
B – Electron beam
C – Ion source (accelerating and focussing slits)
D – Filament
E – Analyser
F – Pumping system
G – Resolving slits
H – Ion collector
I – Amplifying system
J – Recording or data processing (10)

[25]

QUESTION 5

5.1 5.1.1

$$Cv = 1{,}16\ Q\sqrt{\frac{Gf}{\Delta P}}$$

$$75 = 1{,}16 \times Q \times \sqrt{\frac{1}{1{,}5}}$$ ✓✓

$= 79{,}18\ m^3/h$✓

5.1.2

$$\text{Rangeability} = \frac{\max\ flow}{\min\ flow}$$

$$46 = \frac{79{,}18}{\min\ flow}$$ ✓✓

Min flow = 1,721 m^3/h✓

5.1.3

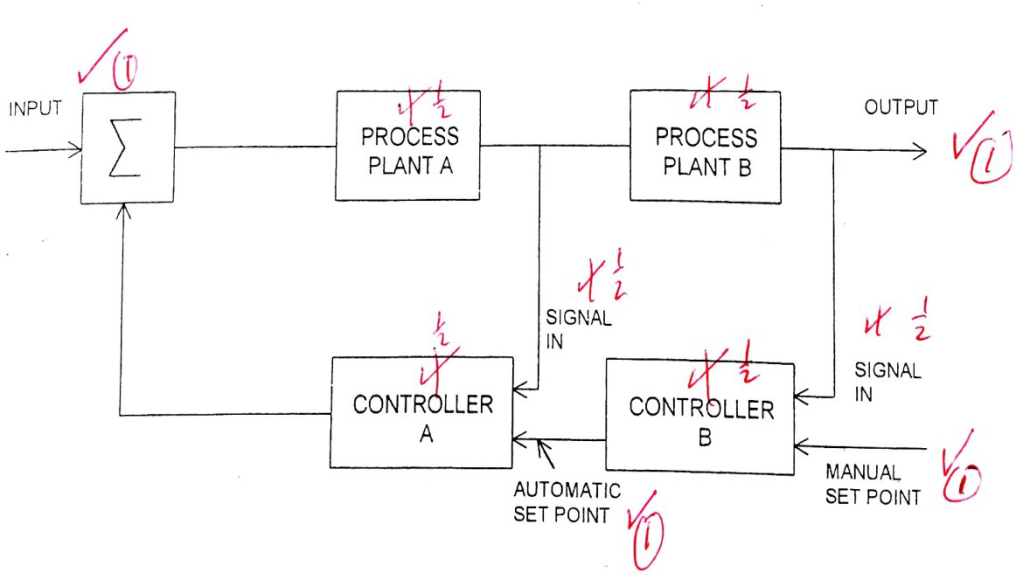
$$\text{Turndown} = \frac{normaloperatingflow}{\min\ flow}$$

$$42 = \frac{normaloperatingflow}{1{,}721}$$ ✓✓

Normal operating flow =72,282 m^3/h✓

(3 × 3) (9)

5.2



(7)

5.3 Step 1

- Set derivative time to zero.✓
- Start with a wide proportional band and narrow it gradually step by step✓ while observing the behaviour following the set point changes until the desired stability is obtained, i.e. a damping ratio of 0,25.✓

Step 2

- Allowing the proportional band to remain at this setting,✓ increase the derivative time in small steps while creating set point load changes until the cycle behaviour begins to increase,✓ then slightly reduce the derivative time.✓ (6)

[22]

QUESTION 6

6.1 The purpose of the feedwater control system is to maintain the proper amount of water in the drum✓ during all load conditions.✓ (2)

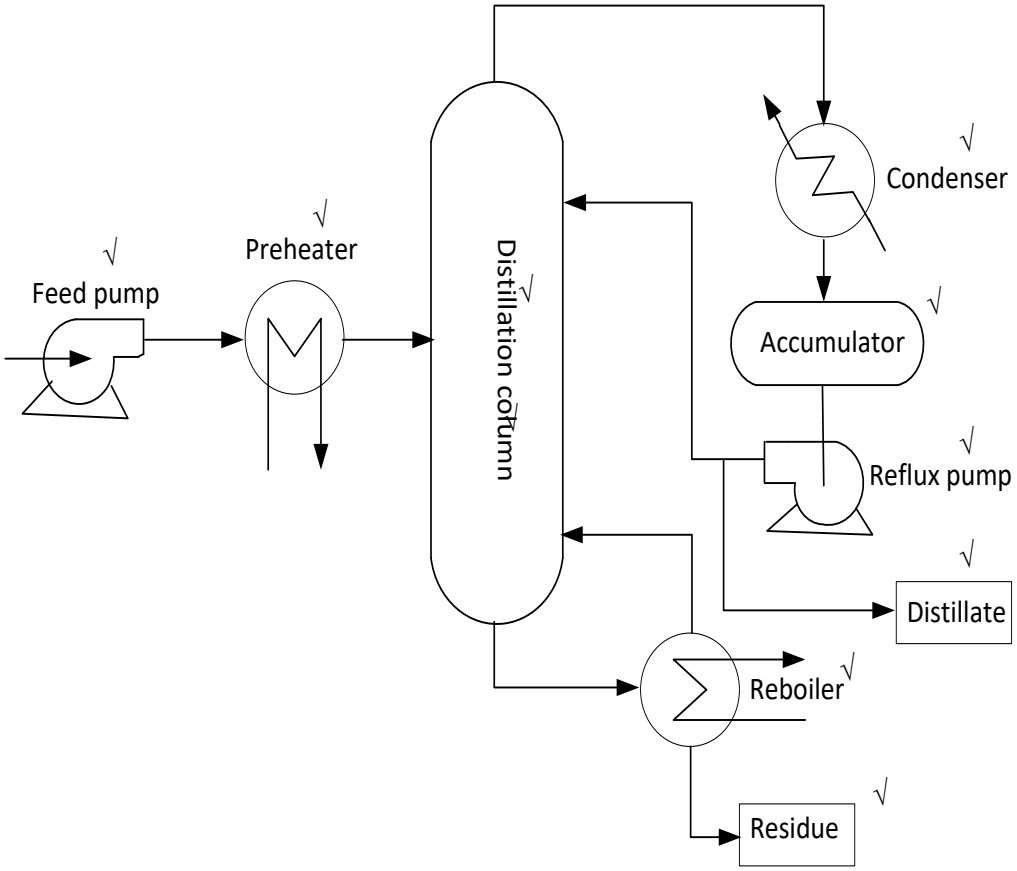
6.2

- The transmitter should be an absolute pressure type
- The pressure transmitter should be mounted above the taps
- The transmitter should have slight bleed of air
- or gas into the line to keep it free of condensate. (4)

6.3

- Pressure in the column
- Flow rate of the incoming feed
- Flow rate of the bottom product or residue
- Flow rate of the top product or distillate
- Column-feed temperature cascaded onto the steam flow to the preheater
- Top temperature control cascaded onto the reflux flow
- Temperature cascaded onto the steam flow control to the reboiler
- Heat removed from the system (8)

6.4



(9)
[23]

QUESTION 7

7.1
- What level of energy is incapable of igniting a hazardous atmosphere mixture?
- What is a specific atmospheric mixture?
- What are normal and abnormal conditions? (3)

7.2 It prevents the output signal in the field from releasing sufficient electrical or thermal energy under normal or abnormal conditions to ignite a specific hazardous atmospheric mixture.

OR

It prevents high voltage and currents to flow through the hazardous area. (3)

7.3
- Series protective elements
- Transformer construction
- Shunt protective elements
- Zener barrier (4)

[10]

TOTAL SECTION B: 80
GRAND TOTAL: 100