higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL INSTRUMENTS N6

15 November 2022

This marking guideline consists of 7 pages.

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QUESTION 1

1.1 1.1.1 The ratio of the intensity of magnetisation of the material to the intensity of the magnetising field is called the volume susceptibility of the material.

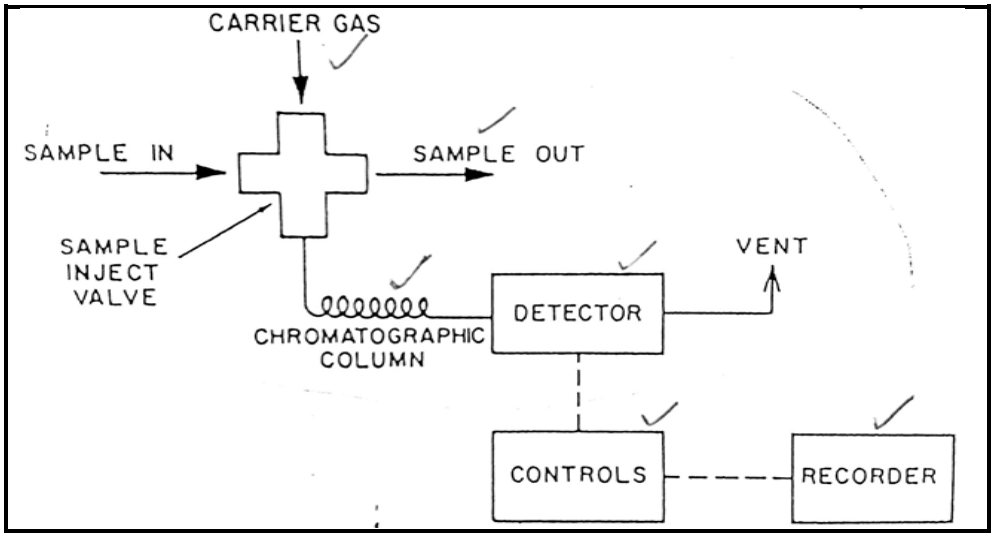
1.1.2 It is a substance that is magnetised in the opposite direction to that of the magnetising field or having negative volume susceptibility, thus tending to go to the weakest part of the magnetising field.

(2 × 2) (4)

1.2 Broad-emission sources
- Hydrogen discharge lamps
- Tungsten lamps
- Tungsten-iodine lamps

Discrete-line source
- Mercury discharge lamp (4)

1.3 1.3.1

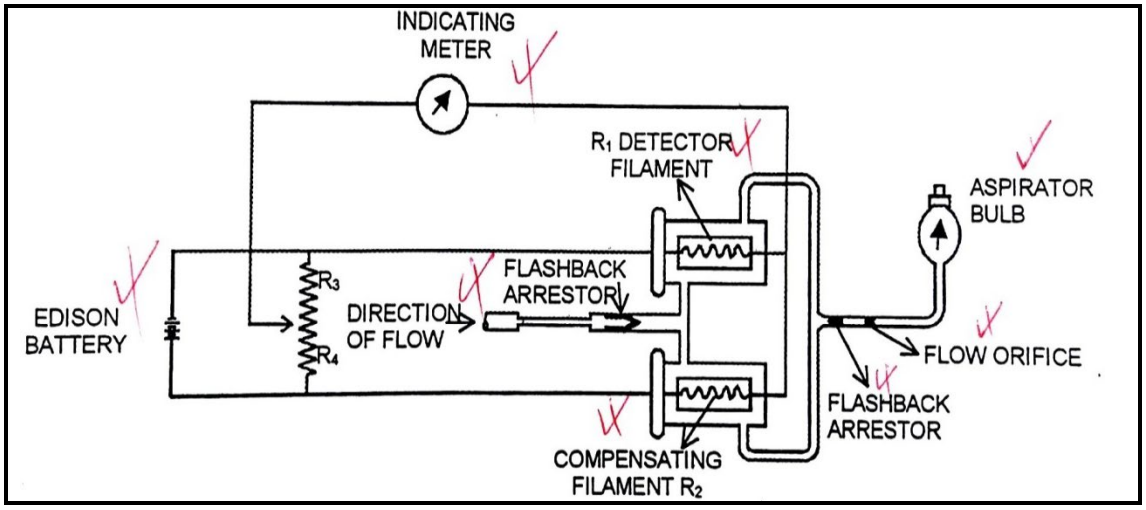


(6)

1.3.2
- The process chromatograph takes a fixed volume of sample gas or liquid in vapour form and introduces it into the chromatographic column.
- The column consists of a finely granulated absorbent material packed in conventional drawn tubing.
- As the sample progresses through the column, individual molecules of gas are absorbed, then released at different times from the column particle surfaces.
- When the column is properly selected, the components of interest emerge from the column completely separated from one another and from other components.
- This emerging stream passes through the detector. (5)

1.3.3
- Temperature
- Carrier gas flow and pressure
- Sample and column valve actuations
- Detector sensitivity
- Event programming (5)

1.4



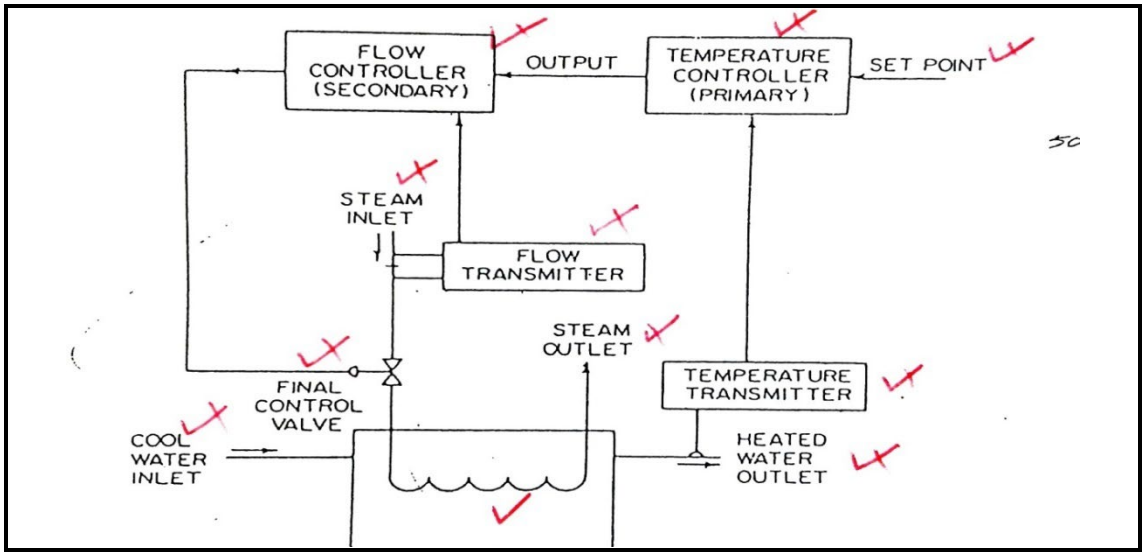
(4)
[28]

QUESTION 2

2.1 2.1.1
- With closed-loop control, the actual output is measured and compared to the desired output value.
- If there is any deviation between the two, the closed-loop system acts to correct it.
- A return signal is provided from a measured output variable to the controlling device. (3)

2.1.2 Multi-element control occurs when two or more input signals jointly effect the action of the control system. (2)

2.2



(6)

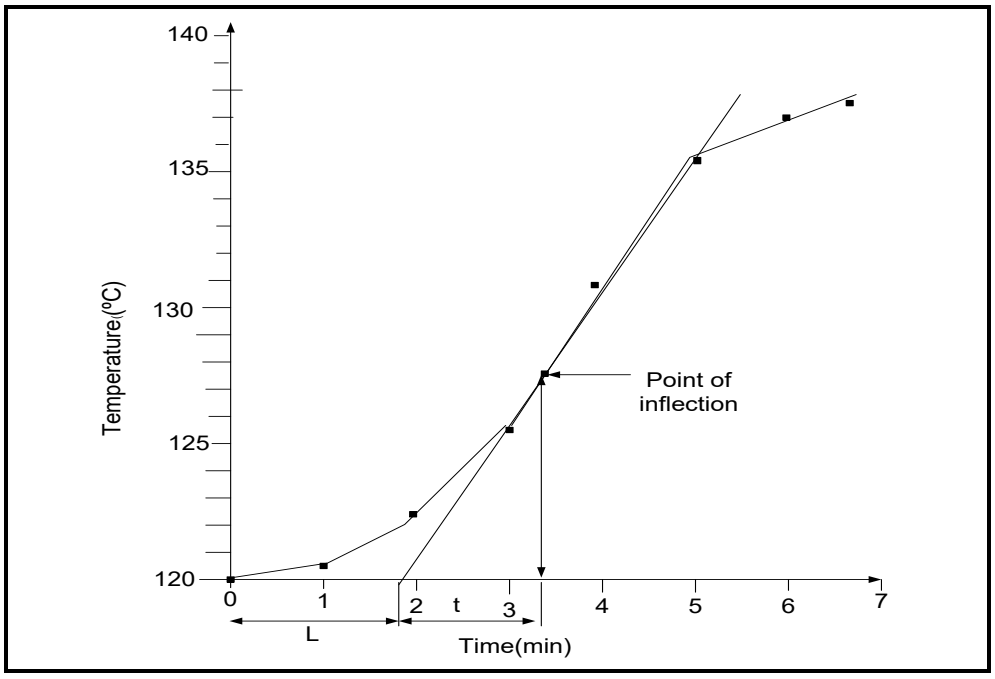
2.3 $$C_v = \frac{Q}{295}\sqrt{\frac{G.T}{\Delta P(P_1+P_2)}}$$

$$1{,}5 = \frac{Q}{295}\sqrt{\frac{0{,}8 \times (80+273)}{(13{,}79-3{,}4475)[(13{,}79+1{,}0135)+(3{,}4475+1{,}0135)]}}$$ ✓✓

$$Q = \frac{295\times 1{,}5}{\sqrt{\frac{0{,}8\times(80+273)}{(13{,}79-3{,}4475)[(13{,}79+1{,}0135)+(3{,}4475+1{,}0135)]}}}$$ ✓

$Q = 371{,}73\ m^3/hr$ ✓ (4)

2.4 2.4.1



(3)

2.4.2 Process range : 100 °C to 200 °C = 100 °C✓
Reaction range: 120 °C to 137,5 °C = 17,5 °C✓

Point of inflection = $\frac{\text{reaction range}}{2}$

$= \frac{17{,}5\ °C}{2}$

$= 8{,}75\%$ ✓

- L=2min,from graph✓
- Time (t) = 1,5 min, from graph✓
- ΔP = [45–25]% = 20%✓

$$\% \text{ change in variable} = \frac{\text{Point of inflection}}{\text{Process range}} \times 100$$

$$= \frac{8,75}{100} \times 100 \checkmark$$

$$= 8,75\% \checkmark$$

$$R = \frac{\% \text{ change in variable}}{\text{time in minutes}}$$

$$= \frac{8,75}{1,5} \checkmark$$

$$= 5,833\% \checkmark$$

$$\text{Proportional band} = \frac{100\ RL}{\Delta P}$$

$$= \frac{100 \times 5,833 \times 2}{20} \checkmark$$

$$= 58,33\% \checkmark$$

$$\text{Integral rate (r/m)} = \frac{0,3}{L}$$

$$= \frac{0,3}{2} \checkmark$$

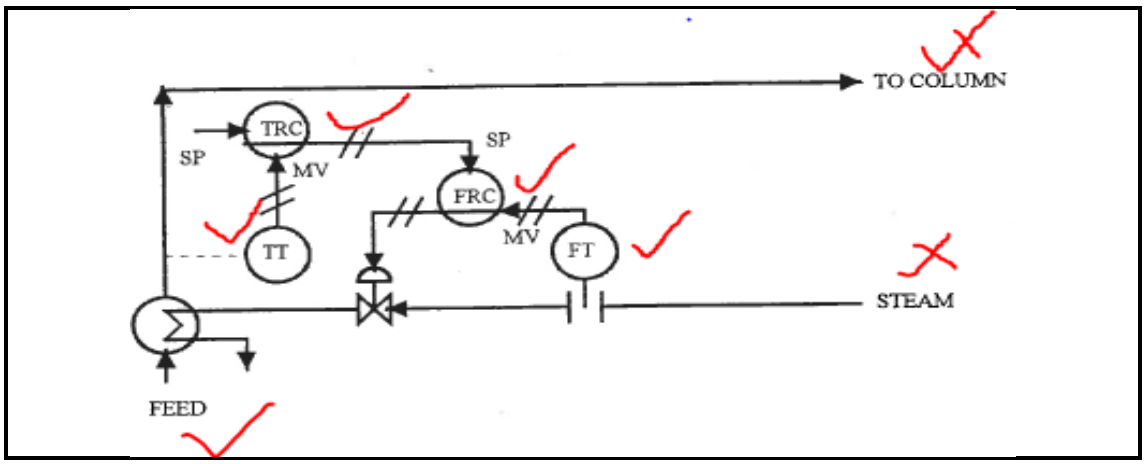
$$= 0,15 \text{ r/min} \checkmark \quad (14)$$

[32]

QUESTION 3

3.1
- Sieve trays
- Valve trays
- Bubble-cap trays (3)

3.2



(6)

3.3 A condenser is a heat exchanger. As the hot vapour comes into contact with the coils, it condenses and is collected in the overhead accumulator. (2)

3.4 Boiler load is a term used to describe the plant's demand for steam. (2)

3.5

3.5.1
- In a natural-draft furnace, buoyancy forces induce draft as the hot air rises through the stack and creates a negative pressure inside the firebox.
- This pressure is lower than normal atmospheric pressure.

3.5.2
- Forced-draft furnaces use a fan to push fresh air to burners for combustion.
- Forced draft is used in furnaces that preheat the combustion air to reduce fuel requirements.

3.5.3
- In an induced-draft furnace a fan located below the stack pulls air up
- through the firebox and out of the stack.

3.5.4
- Balanced-draft furnaces require two fans: one inducing flow out of the stack
- and one providing positive pressure to the burners.

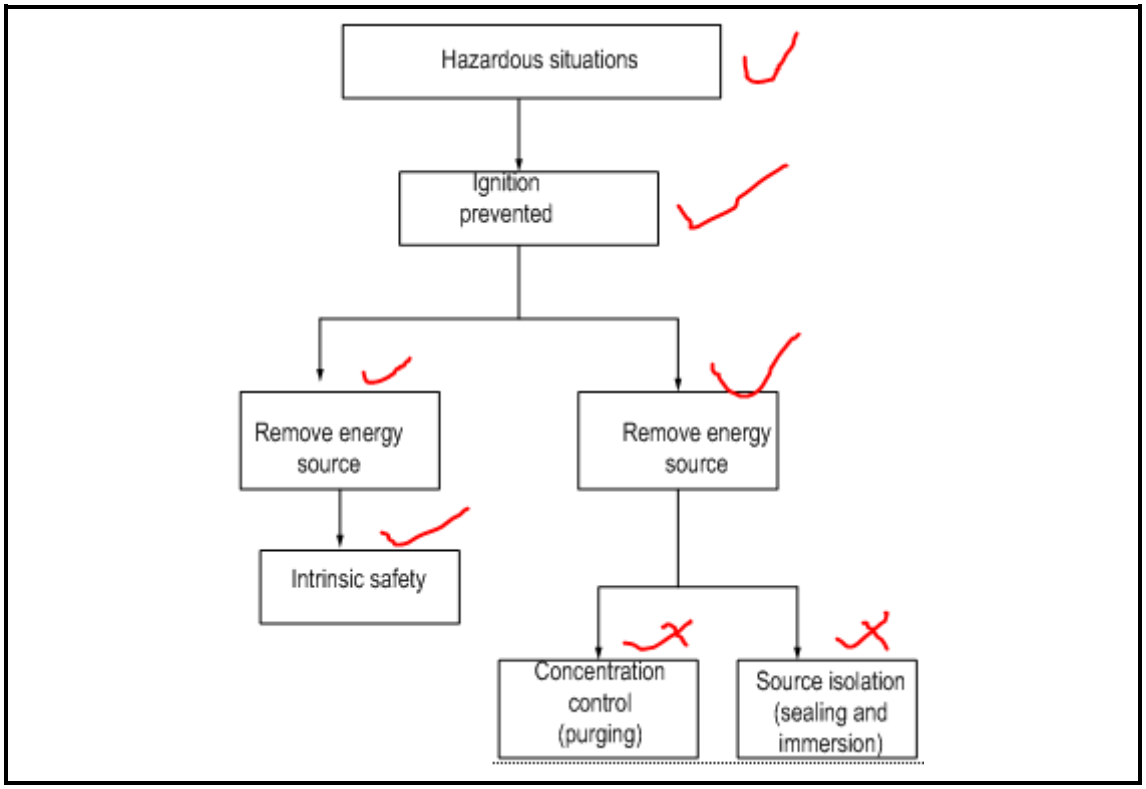
(4 × 2) (8)

3.6
- As water is heated, bubbles due to steam start to form in the water.
- It is this steam that is drawn off.
- As the load on the boiler increases, more bubbles are formed, that is, the volume of these bubbles can increase or decrease rapidly, giving a false indication of a changing water level in the drum.
- When the steam bubbles expand, this is known as 'drum swell' and when they contract, it is called 'drum shrink'. (4)

[25]

QUESTION 4

4.1



(6)

4.2 Potting is when equipment is immersed in a liquid or solid material, usually sand or inert oil.✓✓ This quenches any sparking that may occur from components during installation.✓ (3)

4.3 Non-incentive equipment is incapable in their normal operating condition of releasing sufficient energy to ignite a specific hazardous atmospheric mixture.

OR

It is a type of protection in which the equipment is incapable,✓ under normal conditions, of causing ignition of a specified flammable gas or vapour-in-air mixture due to arcing or thermal effect.✓✓ (3)

4.4
- Grounded safety barriers
- Grounded repeaters
- Ungrounded repeaters

(3)
[15]

TOTAL: 100

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