



**higher education  
& training**

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

# **MARKING GUIDELINE**

**NATIONAL CERTIFICATE**

**PLANT OPERATION THEORY N3**

**2 August 2021**

**This marking guideline consists of 7 pages.**

**QUESTION 1: CHEMISTRY AND CATALYSTS**

- 1.1 1.1.1 The solvents in which the monomers dissolve and grow to polymers are usually chemically inactive. It diffuses the monomers and retards the polymerisation reaction.✓

The strength of the solution controls the speed of the reaction and the temperature.✓ The product that forms polymers can either be partially or totally or not at all soluble in the solvent.✓ When both the monomers and the polymers are soluble in the solvent, the polymers begin to form in the oil or organic stage.✓ When only the monomer is soluble in the solvent, the polymerisation takes place in the liquid phase and polymers with a high molecular mass are formed.✓ When the polymer is more soluble than the monomer, molecules with a lower molecular mass forming.✓

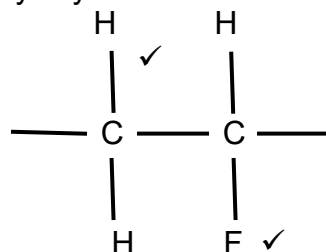
(6)

- 1.1.2 Polymerisation is brought about in a water medium that contains an emulsifier, (soap), and also contains a medium that is soluble in water and initiates the process.✓

This process is much faster than the other at the same temperature and polymers with a larger molecular mass are formed.✓ This reaction takes place within the small bubbles that consist of soap layers.✓ Control over the concentration of the emulsion, leads to control in the rate of the reaction, the distribution of the reaction heat as well as the temperature.✓

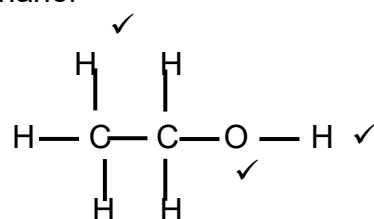
(4)

- 1.2 1.2.1 Polyvinyl Fluoride



(2)

- 1.2.2 Ethanol



(3)

- 1.3
- Cobalt
  - Nickel
  - Ruthenium
  - Palladium
  - Iridium
  - Platinum
  - Copper

(Any 5 × 1)

(5)  
**[20]**

**QUESTION 2: COMBUSTION; COOKING AND GASIFICATION OF COAL**

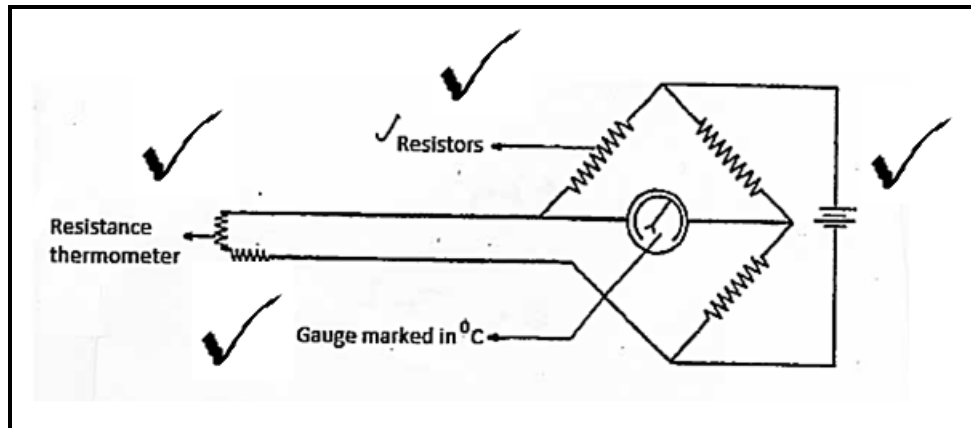
- 2.1  $12 + 32 = 44 \text{ g/mol} \checkmark$   
 12 g mass of carbon require 32g mass of  $O_2$   
 $5 \text{ Kg of C} = \frac{32}{12} \times 5 \text{ kg}$   
 $= 13 \text{ kg} \checkmark$   
 Amount of air required  
 Air contains 26% of Oxygen by mass  
 $\text{Air required} = \frac{100}{26} \times 13 \text{ kg} = 50 \text{ kg} \checkmark$   
 $\text{Ratio} = \frac{\text{Air}}{\text{Fuel}} = \frac{50 \text{ kg}}{5 \text{ kg}} = 10 \checkmark$   
 10kg air is required for each kg of fuel  $\checkmark$  (5)
- 2.2  $h_{ws} = \text{mass} (h_f + q_{hfg} - c \times t_f)$   
 $= 2 (815 + 0,9 \times 1971 - 4187 \times 20) \checkmark \checkmark$   
 $= 5010 \text{ kJ} \checkmark$   
 $\text{Energy released by fuel} = \frac{h_{we} \times 100}{30} \text{ KJ / Kg}$   
 $= \frac{5010 \times 100}{30} \checkmark$   
 $= 16700 \text{ kJ for each steam} \checkmark$  (5)
- 2.3
- Iron pyrite
  - Sulphates
  - Unbonded Sulphur
  - Organic compounds of Carbon and Hydrogen
- (4)
- 2.4
- Complete analysis
  - Short analysis
  - Microscopic examination
- (3)
- 2.5
- $C + O_2 \longrightarrow CO_2 \checkmark$
  - $CO_2 + C \longrightarrow 2CO \checkmark$
  - $C + H_2O \longrightarrow CO + H_2 \checkmark$
  - $C + 2H_2O \longrightarrow CO_2 + 2H_2 \checkmark \checkmark$
  - $CO + H_2O \longrightarrow CO_2 + H_2 \checkmark \checkmark$
- (8)
- [25]**

**QUESTION 3: HEAT TRANSFER, HEAT EXCHANGER AND THERMAL INSULATION**

- 3.1
- Chemical reactions
  - Friction or mechanical energy
  - Electrical energy
  - Splitting of atoms or nuclear energy

(4)

3.2



(4)

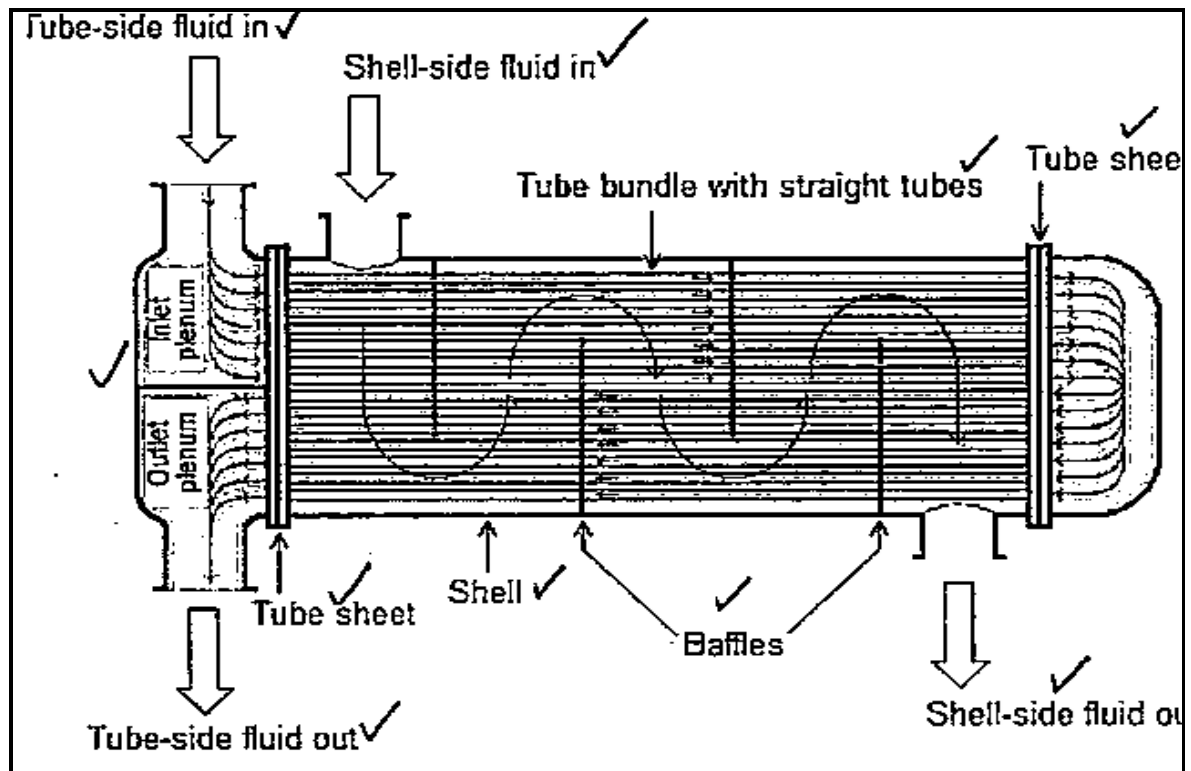
- 3.3
- Water✓
  - Aluminium✓
  - Copper✓
  - Silver✓

OR

Water✓, aluminium✓, copper✓, silver✓

(4)

3.4



(10)

- 3.5 Efficiency of heat exchanger is an indication of the degree of effective operation of the apparatus✓ and is closely related to the coefficient of exchange of heat (also known as the 'U' factor of heat exchange).✓  
The 'U' of heat exchangers are determined by maintaining a constant flow of the fluids through the heat exchanger and measuring the inlet and outlet (exhaust) temperatures of the media flowing through the exchanger.✓

(3)

**[25]****QUESTION 4: PUMPS AND COMPRESSION**

- 4.1
- Piston pumps
  - Plunger pumps
  - Diaphragm pumps
- (3)
- 4.2
- Usually the pump is self-primed✓ and is immersed✓ in the liquid or suction is supplied under positive liquid head✓.
  - Care✓ must be taken to ensure that the delivery valve✓ is always open✓ while in use.
  - These pumps are usually driven✓ at high speed✓ requiring relatively low power✓. (Any other 2 × 3)
- (6)
- 4.3
- P: Pressure of the gas✓
  - V: Volume of the gas✓
  - M: Mass of the gas✓
  - R: Characteristics constant of that gas✓. corresponding to the specific heat capacity of the gas✓
  - T: Absolute temperature of the gas✓
- (6)
- 4.4
- They attain high pressures though at lower volume
  - Their efficiency is higher – the workdone for energy input is higher
  - They are not affected so much by drop in suction pressures-the suction pressure may be low. (Any other 3 × 1)
- (3)

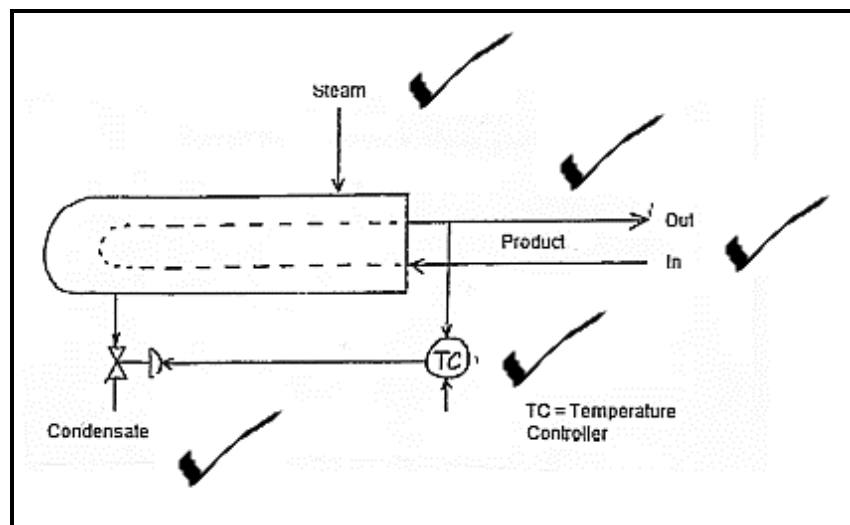
**[18]**

**QUESTION 5: INSTRUMENTATION AND CONTROL SYSTEM**

- 5.1
- Air inlet connector
  - Valve house OR valve body
  - Diaphragm
  - Springs
  - Lever
  - Valve stem
  - Position indicator
  - Actuator assembly
  - Piston
  - Air connection

(Any other 3 × 1) (3)

5.2



(5)

- 5.3
- On-off control
  - Proportional control
  - Reset action
  - Rate or derivative action
  - Proportional plus reset
  - Proportional plus rate
  - Proportional plus reset plus rate

(4)  
[12]**TOTAL: 100**