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.

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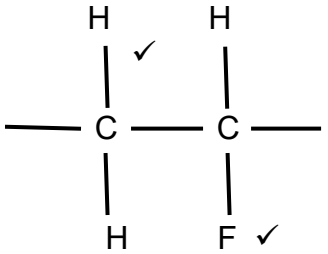
QUESTION 1: CHEMISTRY AND CATALYSTS

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)

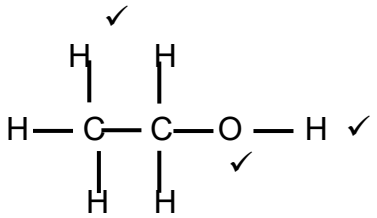
1.1.2 Polymerisation is brought about in a water medium that contains an emulsifier, (soap), and also contains a medium that is soluble in water and initiates the process.✓
This process is much faster than the other at the same temperature and polymers with a larger molecular mass are formed.✓ This reaction 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 g/mol✓
12 g mass of carbon require 32g mass of O_2
5 Kg of C = $\frac{32}{12} \times 5kg$
= 13 kg ✓
Amount of air required
Air contains 26% of Oxygen by mass
Air required = $\frac{100}{26} \times 13kg$ = 50 kg✓
Ratio = $\frac{Air}{Fuel}$ = $\frac{50kg}{5kg}$ = 10✓
10kg air is required for each kg of fuel✓ (5)

2.2 h_{ws} = mass (h_f + q_{hfg} – c × t_f)
= 2 (815 + 0,9 ×1971 – 4187×20)✓✓
= 5010 kJ✓
Enegy released by fuel = $\frac{h_{we} \times 100}{30} KJ/Kg$
= $\frac{5010 \times 100}{30}$ ✓
= 16700 kJ for each steam✓ (5)

2.3
- Iron pyrite
- Sulphates
- Unbonded Sulphur
- Organic compounds of Carbon and Hydrogen (4)

2.4
- Complete analysis
- Short analysis
- Microscopic examination (3)

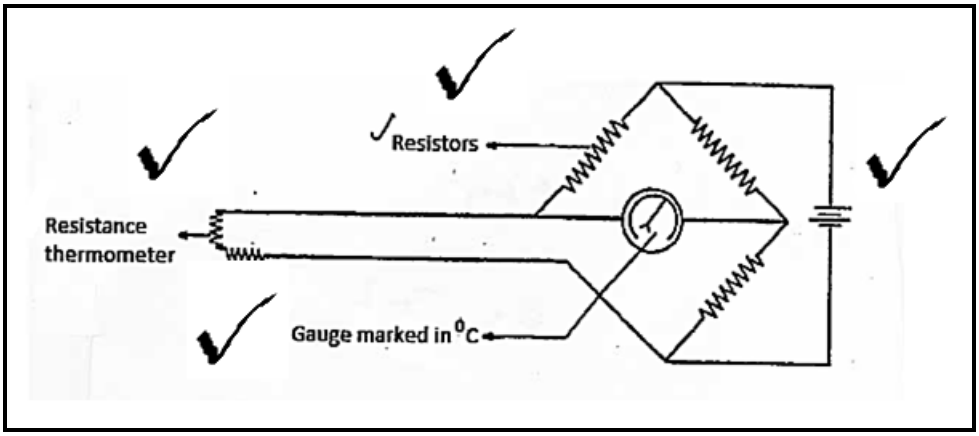
2.5
- $C + O_2 \longrightarrow CO_2$ ✓
- $CO_2 + C \longrightarrow 2CO$✓
- $C + H_2O \longrightarrow CO + H_2$✓
- $C + 2H_2O \longrightarrow CO_2 + 2H_2$✓✓
- $CO + H_2O \longrightarrow CO_2 + H_2$✓✓ (8)

[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



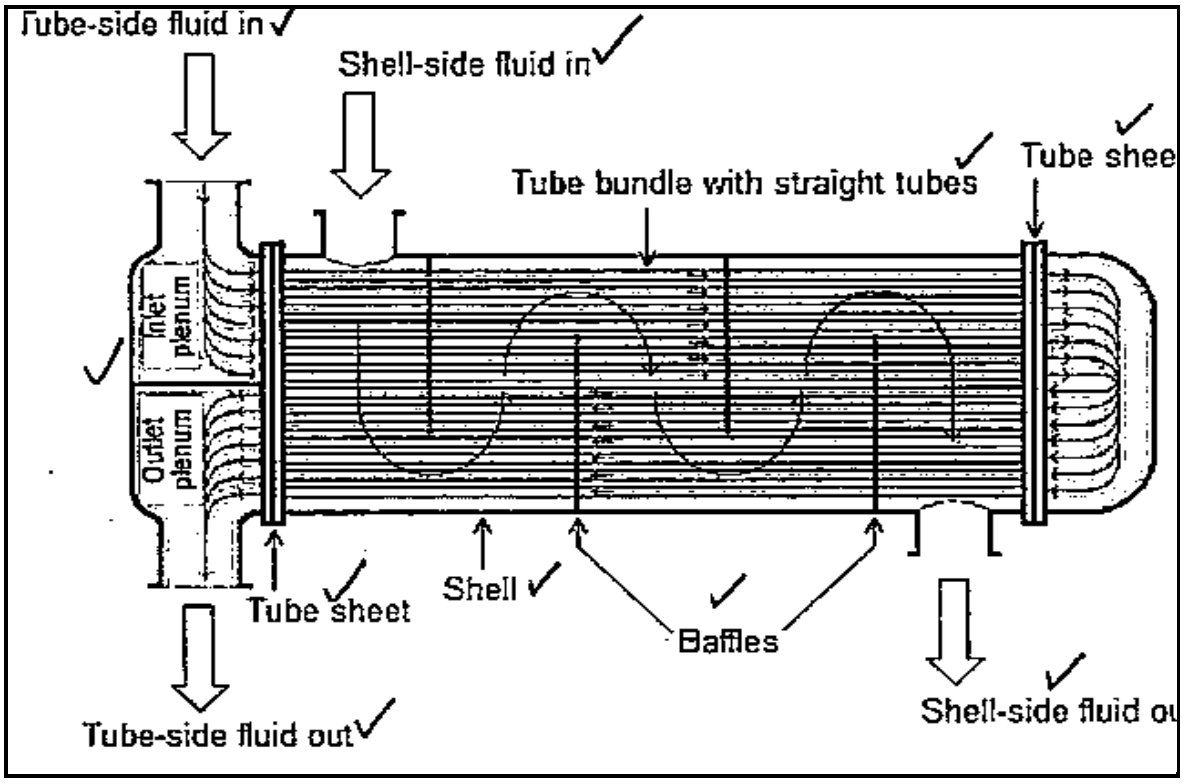
(4)

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 coeffecient of exchange of heart (also known as the 'U' factor of heart 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)

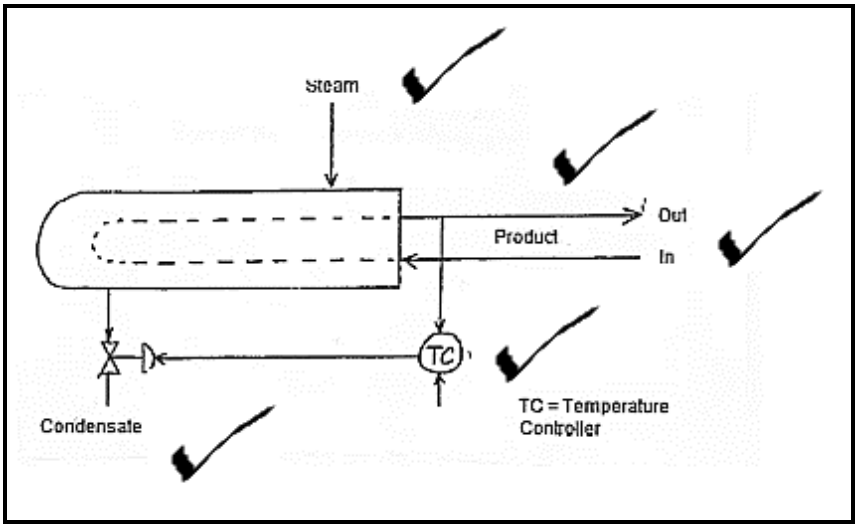
4.4
- They attain high pressures though at lower volume
- Their efficiency is higher – the workdone for energy input is higher
- They are not affected so much by drop in suction pressures-the sunction pressure may be low. (Any other 3 × 1) (3)

[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

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