



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N3

2 AUGUST 2019

This marking guideline consists of 5 pages.

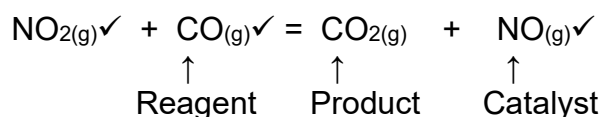
QUESTION 1: CHEMISTRY AND CHEMICAL PROCESSES

- 1.1
- The type of coal that is being used
 - Products that are required
 - Specific temperature of carbonisation
 - Physical condition of the coal, e.g. size
- (4)

- 1.2 $\text{NO}_{(g)} + \text{O}_{2(g)} \checkmark = \text{NO}_{2(g)} \checkmark$ ----- intermediary medium

Catalysis

Reagent



(5)

- 1.3 1.3.1
- Polyethylene bags
 - Film wrap
 - Sweet wrappers
 - Plastic bags
 - Containers
 - bottles
- (Any applicable 2 × 1) (2)

- 1.3.2
- Safety glasses
 - Boats
 - Bathroom applications
 - Furniture applications
- (Any applicable 1 × 1) (1)

- 1.3.3
- Piping
 - Tubing
 - Cables
 - Electronic applications
- (Any applicable 1 × 1) (1)

- 1.4 $2\text{KClO}_{3(s)} \checkmark + \text{MnO}_{2(s)} \checkmark \longrightarrow \text{MnO}_2 \checkmark + 2\text{KCl} \checkmark + 3\text{O}_2 \checkmark$
- (5)

- 1.5
- Promote a chain reaction of atoms within the reacting molecules.
 - Re-arrangement of atoms in all the reacting molecules without loss of atoms (monomer and polymer).
 - A ring bond of atoms split and bonds with another ring bond (molecule) with the aid of a catalyst.
 - Polycondensation is where the molecules condense to form small molecules $\checkmark$ like water, ammonia, hydrogen chloride and others. $\checkmark$
- (5)

- 1.6 Heterogeneous catalysis is when the reactants and the catalysts are in different phases $\checkmark \checkmark$ e.g. the reactants may be gaseous and the catalyst solid.
- (2)
[25]

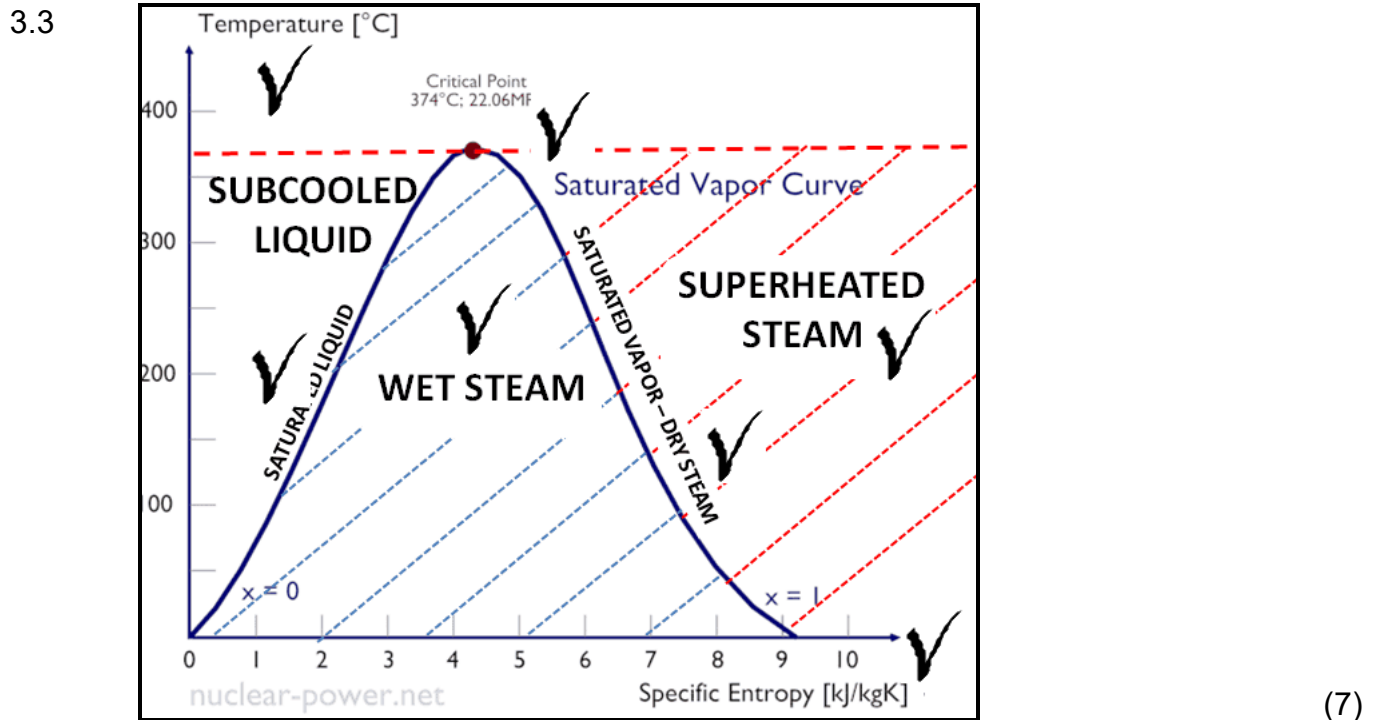
QUESTION 2: COMBUSTION, FUELS AND THERMAL INSULATION

- 2.1 2.1.1 It has a natural resistance to dampness/vapour. (Any applicable 1 × 1) (1)
- 2.1.2 Cork (Any applicable 1 × 1) (1)
- 2.1.3 • It consists of separate air-filled pieces of material.
 • It and can be loose or in prepared sheets.
 • The cells that are normally formed by this material have hollows that are filled with air or gas. (Any applicable 3 × 1) (3)
- 2.2 • The combustion process cannot be easily controlled.
 • They form large amounts of ash and its disposal is a big problem.
 • A large space is required for storage (Any applicable 2 × 1) (2)
- 2.3 • Cleanliness
 • Easy to control
 • The calorific value is comparatively lower.
 • Less handling of equipment and thus less labour required
 • Affordable
 • Better for environment
 • More dependable
 • A domestic source of energy (Any applicable 4 × 1) (4)
- 2.4 • Enough air (oxygen)
 • Thorough mixing of air and fuel
 • Furnace temperature above ignition temperature of the fuel
 • Enough time (4 × 1) (4)
- [15]**

QUESTION 3: STEAM BOILERS AND STEAM TRAPS

- 3.1 3.1.1 • It is the measure of the heat content✓ of a substance and is determined by both the temperature and pressure of the substance.✓
- OR
- The total amount of heat✓ in one kg of a substance calculated from accepted temperature base✓ (2)
- 3.1.2 After the flue-gas left the super-heated tubes, it still contains energy. This energy is utilised to heat feed-water by means of the economiser. This is conducted to the feed-water, causing the water temperature to rise. (2 × 1) (2)

3.2 $h_{su} = h_f + (x h_{fg}) + [C_s (t_{su} - t_s)]$
 Energy to be added = $(x h_{fg}) + [C_s (t_{su} - t_s)]$
 Energy to be added = $[(1-0,7)] \times 1802 + [6,8 \times (250 - 232)] \checkmark \checkmark$
 $= 540,6 + 122,4 \checkmark$
 $= 663 \text{ KJ/Kg} \checkmark$
 Steam rate = 3 tons/h
 $\therefore$ Amount of energy required = $3 \times 663 \div 10^3 \text{ GJ/h} \checkmark$
 $= 1,989 \text{ GJ /h} \checkmark$ (6)



- 3.4
- Mechanical traps
 - Thermostatic steam traps
 - Thermodynamic steam traps
- (3 × 1) (3)
[20]

QUESTION 4: HEAT TRANSFER

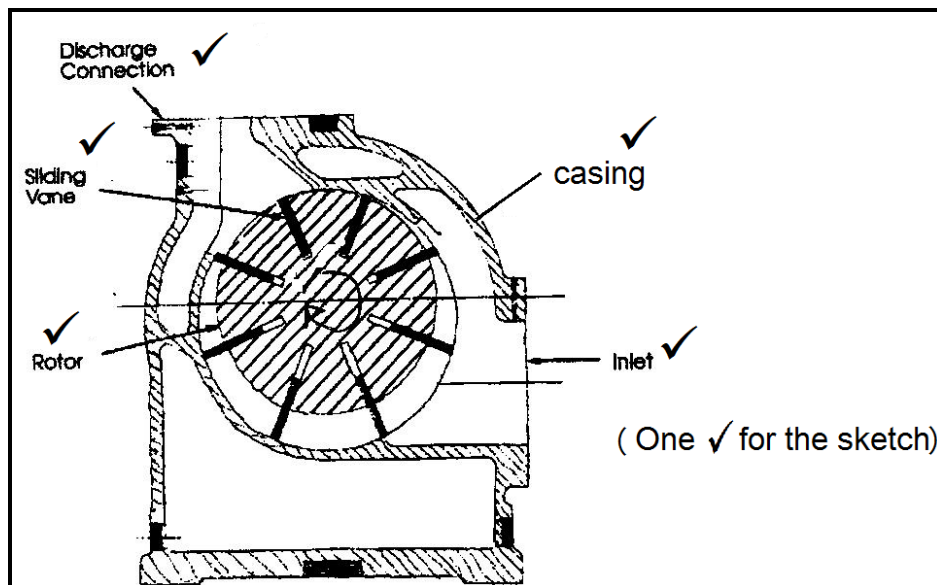
- 4.1
- Spray ponds
 - Cooling towers
 - Fractionation and distillation columns
 - Steam strippers
 - Absorbers
- (5 × 1) (5)
- 4.2
- Impure Material:✓ This media is sent through the tube side not to accumulate (tube replacing is easier than to cap).✓
 - High Pressure Medium:✓ It is sent through the tubes because they can resist higher pressure than the shell side.✓
 - Water:✓ Water is a scale former and flow velocity reduces scale forming, thus water is normally sent through the tubes.✓
 - Pressure Loss:✓ When pressure losses are not a matter of importance the medium is sent through the tubes, because high-pressure losses result through the tubes.✓
 - Smaller Volume:✓ The smaller volume medium goes through the tubes as the shell side can handle larger volumes.✓
 - Non-condensable gasses:✓ E.g. air is usually sent through the tubes because the gases in the shell side can accumulate in stagnant areas and thus lower the efficiency of the exchanger.✓
- (Any 6 × 2) (12)
- 4.3
- Convection
 - Radiation
 - Conduction
- (3 × 1) (3)
- [20]**

QUESTION 5: COMPRESSION, COOLING, PUMPS AND INSTRUMENTATION

- 5.1 5.1.1 False
 5.1.2 False
 5.1.3 False
 5.1.4 True
 5.1.5 False

(5 × 1) (5)

5.2



(6)

- 5.3 These pumps run silently at high speeds and force the liquid through the gears.✓ They build up high pressures but cannot handle large volumes and are used to displace liquids with a high viscosity like oil.✓

As a result of the small volume they handle, they are unable to build up a high suction side✓ and thus must be placed in a position at the inlet side where they are submerged in the liquid.✓

(4)

- 5.4 • Piston or plunger pumps
 • Diaphragm pumps
 • Rotary pumps

(3 × 1) (3)

- 5.5 • Absolute pressure is gauge pressure plus atmospheric pressure at sea level.
 • It is 101,32 KPa at sea level.

(2 × 1) (2)

[20]**TOTAL: 100**