higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

10 August 2021

This marking guideline consists of 5 pages.

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QUESTION 1

1.1 False
1.2 True
1.3 True
1.4 False
1.5 False

(5 × 1) **[5]**

QUESTION 2

2.1 E
2.2 G
2.3 H
2.4 A
2.5 C

(5 × 1) **[5]**

QUESTION 3

3.1 The amount of mechanical energy necessary to balance the output energy✓ against the input energy in a total mechanical energy balance.✓ (2)

3.2 The loss in mechanical energy caused by friction effects (1)

3.3 It is the hammering sound✓ heard when a valve is suddenly closed in a long pipe containing flowing water.✓ This results in vibrations and undue stress on the pipe✓ and may eventually cause the pipe to break.✓ (4)

3.4 By closing the valve slowly✓ or by using surge chambers or a relief spring.✓ (2)

3.5 3.5.1

$$A = \pi r^2$$
$$= \pi\ (0{,}295)^2 \checkmark$$
$$= 0{,}273\ m^2 \checkmark$$

Average linear velocity $V = \frac{v}{t \times A}$

$$= \frac{0{,}173 \checkmark}{3\,600 \times 0{,}273 \checkmark}$$
$$= 1{,}761 \times 10^{-4} m/s \checkmark$$ (5)

3.5.2

$$NR_e = \frac{DV\rho}{\mu}$$
$$= \frac{0.59 \times 1.76 \times 10^{-4} \times 581 \checkmark}{0.023 \checkmark}$$
$$= 2{,}623 \checkmark$$

The type of flow is streamline flow or laminar flow. ✓ (4)

3.6
- Potential energy
- Kinetic energy
- Internal energy

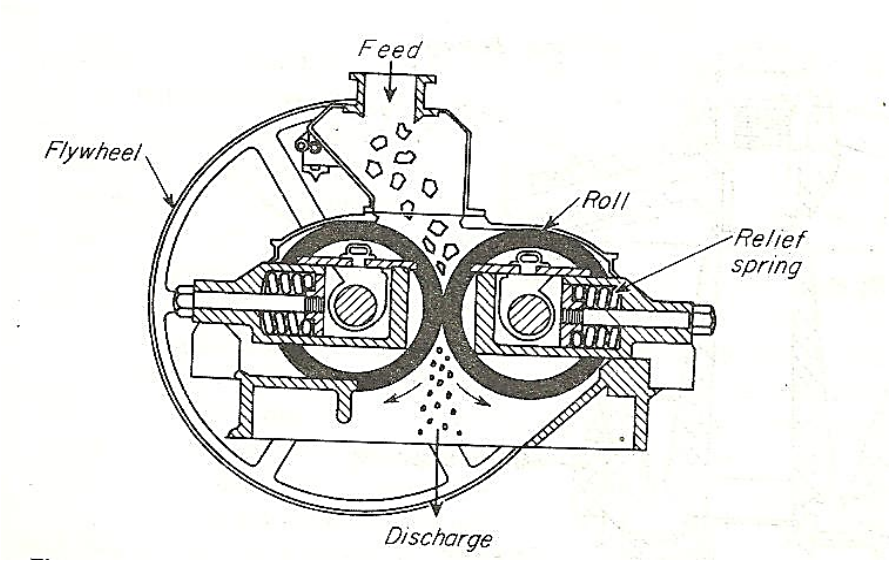
(Any 2 × 1) (2)
[20]

QUESTION 4

4.1
- Grinders are a variety of size-reduction machines for intermediate duty.
- The products from a crusher are often fed into a grinder to be reduced to powder. (2)

4.2
A – Stationary disk
B – Feed
C – Rotating disk
D – Casing
E – Discharge (5)

4.3



ONE mark for each correct label (5)

Two heavy smooth-faced metal rolls turning on horizontal and parallel are the working elements of the smooth-roll crusher.✓ Particles of feed caught between the rolls are broken in compression and drop out below.✓ The rolls turn towards each other at the same speed.✓ They have relatively narrow faces and are large in diameter so that they can nip large lumps.✓ The particle size of the product depends on the spacing between the rolls to allow unbreakable material to pass through without damaging the machine. At least one roll must be spring-mounted.✓ (5)

4.4
- Hammer mills, impactors
- Rolling mills, compression mills
- Attrition mills
- Revolving mills (Any 3 × 1) (3)

[20]

QUESTION 5

5.1
5.1.1 Centrifugal compressor
5.1.2 Heat exchanger
5.1.3 Gaseous
5.1.4 Freezes
5.1.5 Heat exchanger
5.1.6 Carbon dioxide (CO_2)
5.1.7 Carbon dioxide (CO_2)
5.1.8 Nitrogen (N_2)
5.1.9 Column
5.1.10 Saturated
5.1.11 Condenser

(11 × 1) 11)

5.2
- Flue gases which result from burning carbonaceous material
- Recovery from the production of ethanol by fermentation
- By-product of lime-kiln operation, where carbonates are calcined to oxides
- Recovery from synthesis gas in ammonia production (4)

5.3
- Manufacturing of ammonia
- Tertiary oil recovery
- Used as a gaseous blanket to exclude oxygen and moisture
- Low temperature metal treatment
- Used in the chemical industry
- Transport of frozen foods (Any 5 × 1) (5)

[20]

QUESTION 6

6.1
6.1.1
- By adding chlorine to an unsaturated bond
- By substitution of hydrogen
- By replacement of another functional group (3)

6.1.2 It is the process whereby a halogen is chemically reacted with a hydrocarbon to form halogenide. (2)

6.1.3 $C_6H_6 + HCl + ½ O_2 \longrightarrow C_6H_5Cl$✓ $+ H_2O$✓ (3)

6.2
- Brass
- Bronze
- Cupro-nickel (3)

6.3
- Cheap
- Common
- Versatile
- Ductile
- Weldable (Any 4 × 1) (4)

[15]

QUESTION 7

7.1
- Cation exchange occurs when the fixed charged groups of the exchanger are negative.
- Anion exchange occurs when the immobilised functional group is positive. (2)

7.2
- Analysis of the raw water
- Heating of the water by exhaust steam
- Mixing and proportioning of the lime and soda ash in conformance with the raw water analysis
- Pumping of the lime-soda mixture into the raw water
- Reacting of lime-soda, facilitated with or without previous heating
- Coagulation or release of super saturation various methods, such as slow agitation or contact seeds
- Settling or removal of the precipitate with or without final filtration
- Pumping away of the softened water
- Periodic washing away of the sludge from the cone tank bottom and from the clarifying filters (9)

7.3
- The amount of molecular oxygen that is required by a microbial population
- to stabilize biodegradable organic material. (2)

7.4 $CaR_2 + 2NaCl \rightarrow 2NaR\checkmark + CaR_2\checkmark$ (2)

[15]

TOTAL: 100

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