higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N6

27 JULY 2018

This marking guideline consists of 5 pages.

QUESTION 1

1.1 True
1.2 False
1.3 False
1.4 True
1.5 False

(5 × 1) **[5]**

QUESTION 2

2.1 H
2.2 E
2.3 C
2.4 D
2.5 B

(5 × 1) **[5]**

QUESTION 3

3.1 3.1.1 Positively charged ions (cations) of a solution which are capable of diffusing through the pores will exchange with the Na+ ions✓ of such a mineral, which is therefore called a cation exchanger. For example Ca^{2+}✓ + Na_2R✓ ⟶ CaR✓ + Na_2✓ where R represents the residual material of the zeolite.✓ In this manner hard water containing Ca^{2+} can be softened by contact with the zeolite,✓ the less objectionable Na+ replacing the Ca^{2+} in the solution and the latter becoming immobilised in the solid.✓ The reaction is reversible, and after saturation with $^{Ca2+}$ the zeolite can be regenerated by contact with a solution of salt.✓
CaR✓ + $2NaCl$✓ ⟶ Na_2R✓ + $CaCl_2$✓ (11)

3.1.2 • Diffusion of ions from the bulk of the liquid to the external surface of exchanger particles
• Diffusion of released ions from the surface of the solid to the bulk of the liquid
• Inward diffusion of the ions through the solid to the site of exchange
• Outwards diffusion of the released ions to the surface of the solid
• Exchange of the ions (5)

3.2

Liquid to be treated ✓

Treated liquid ✓

Regenerating liquid ✓

(a)   (b)   (c)
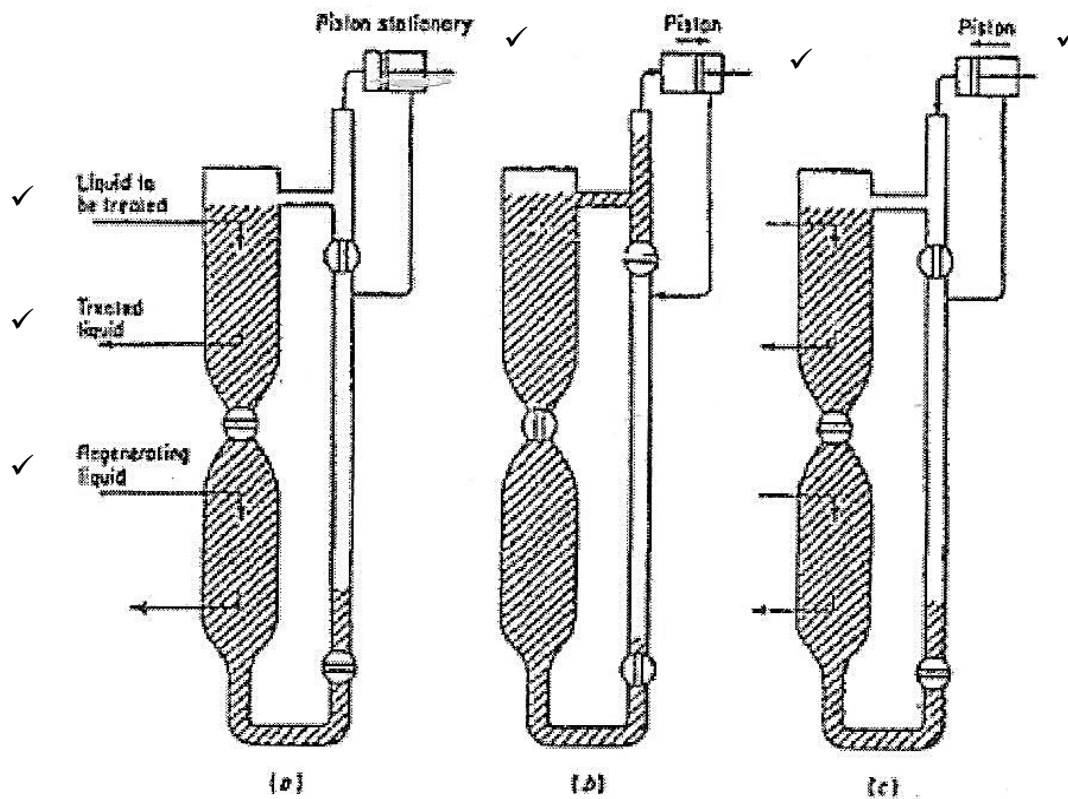
(6)
[22]

QUESTION 4

4.1   4.1.1   It is used to maintain the depth of the liquid and is less sensitive to variation liquid flow rate and also from the departure of the tray from levelness.

        4.1.2   It is used as downspout and not recommended.

        4.1.3   It is used to maintain the depth of the liquid on the tray required from gas contact.

                                                                (3 × 1)   (3)

4.2   4.2.1   Straight weir

        4.2.2   It may result in a hydraulic jump of the liquid.

                                                                (2 × 1)   (2)

4.3   4.3.1   Filtration after chilling is the usual method for the removal of wax from wax distillates.✓ The mixture of wax and adhering oil obtained from the press is frozen and allowed to warm slowly so that oil drains (sweat) from the cake,✓ thus further purifying the wax.✓ Contact filtration involving the use of clay is the common method of purification of oils. Decolourisation takes place at the same time.✓   (4)

        4.3.2   Wax may be removed from the crude oil or from lubricating oil to yield crystalline✓ and microcrystalline waxes of low oil content.✓   (2)

4.4   Beehive coking✓
Oven consists of beehive-shaped brick chamber provided with charging hole at the top of the dome.✓ Discharging hole is found in the lower part of the wall.✓ Coal is introduced through the hole in the dome and spread over the floor.✓ Heat retained is sufficient to start distillation and pyrolysis.✓ The gas given off mixes with the air entering at the top of the discharge door and burns.✓

Coproduct coking✓
It is a narrow chamber tapering in width.✓ These ovens are used for carbonising large amounts of coal.✓ They are built in batteries of 10 to 100 ovens.✓   (10)

A   Petrol
B   Back-flow drum
C   Condenser
D   Liquid overflow pipe (down comers)
E   Naphtha
F   Paraffin
G   Light-fuel gas
H   Live steam
I   Heavy-fuel gas
J   Oven

                                                                              (10 × 1)   (10)
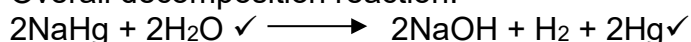   **[31]**

QUESTION 5

5.1   In the mercury cell continuously fed brine decomposes in one compartment (called the electrolyser) between a graphite anode✓ and moving cathode,✓ forming chlorine gas at the anode✓ and sodium amalgam at the cathode.✓ The reactions are:

Overall cell reaction: $2NaCl + 2Hg$✓ $\longrightarrow$ $Cl_2 + 2Na(Hg)$ ✓
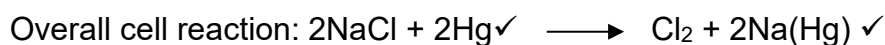
The sodium amalgam flows continuously to a second compartment where it becomes the anode to a short-circuited iron or graphite cathode✓ in an electrolyte of NaOH solution.✓ Purified water is fed to the cell counter current to the sodium amalgam.✓ Hydrogen gas is formed✓ and NaOH is increased to 40 or 50%.✓

Overall decomposition reaction:
$2NaHg + 2H_2O$ ✓ $\longrightarrow$ $2NaOH + H_2 + 2Hg$✓   (13)

5.2 It consists of a tube with an oval section, bent in circular arc.✓ One end of the tube is sealed and attached by a light link to the mechanism which operates the pointer.✓ The other end of the tube is fixed and open for the application of pressure it has to measure.✓ The internal pressure tends to straighten out the tube.✓ The resulting movement of the free end of the tube causes the pointer to move over the scale.✓ (5)

5.3 A Spiral bourdon tube
B Helical bourdon tube

(2 × 1) (2)
[20]

QUESTION 6

6.1 The principal of the movement is that when the liquid flow through the meter it moves a measuring element✓ which seals off the measuring chamber into a series of measuring compartments each holding a definite volume.✓ As the measuring moves, these compartments are successfully filled and emptied.✓ Thus for each complete cycle of the measuring element a fixed quantity of liquid is permitted to pass from the inlet to the outlet of the meter.✓ The seal between the measuring element and the measuring chamber is provided by the film of the measured liquid.✓ The number of cycles of the measuring element is indicated by means of a pointer moving over a dial.✓ (6)

6.2 • Reciprocating piston type
• Rotating or oscillating piston type
• Rotating disc type
• Fluted spiral type
• Sliding vane type
• Rotating vane type
• Oval gear type (Any 4 × 1) (4)

6.3 6.3.1 Fahrenheit scale (1)

6.3.2 Kelvin scale (1)

6.3.3 Celsius designated the ice (freezing) point of water as 0 °C✓ and the steam (boiling) point of water as 100 °C.✓ (2)

6.4 The concept pH is defined as the logarithm of the reciprocal of hydronium ion concentration,✓ or pH = -log [H^+].✓ Thus the pH value of a dilute solution can be easily calculated if [H^+(aq)] is known.✓ (3)
[17]

TOTAL: 100