higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N6

24 November 2023

This marking guideline consists of 7 pages.

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QUESTION 1

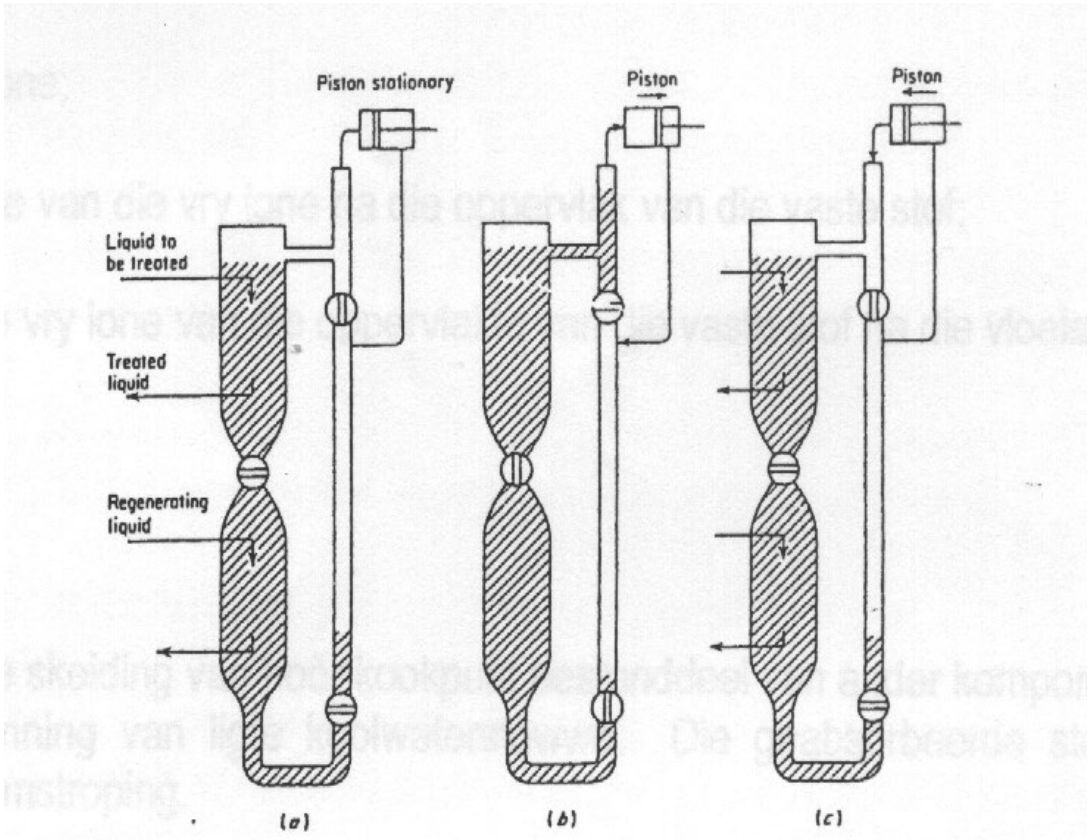
1.1 1.1.1 C
1.1.2 D
1.1.3 B
1.1.4 A
1.1.5 D

(5 × 1) (5)

1.2
- Heavy minerals oils
- Heavy flotation oils
- Waxes
- Lubricating oils (4)

1.3
- Turbo trays
- Kittle trays
- Ripple trays
- Lava trays (4)

1.4



(1 mark for correct drawing and 5 marks for labels) (6)

1.5 1.5.1 It refers to the removal of wax from wax distillates.✓ The mixture of wax and adhering oil is frozen and allowed to warm slowly so that the oil drains from the cake, purifying the wax.✓

1.5.2 Wax is removed from crude oil or lubrication oil by means of crystallisation.✓ Therefore, crystallisation is use to separate liquid solids.✓

1.5.3 It involves the removal of a component from a liquid by means of the selective solvent action of another liquid.✓ Uses: Refining of lubricant oils and production of benzene, toluene and xylenes.✓

(3 × 2) (6)
[25]

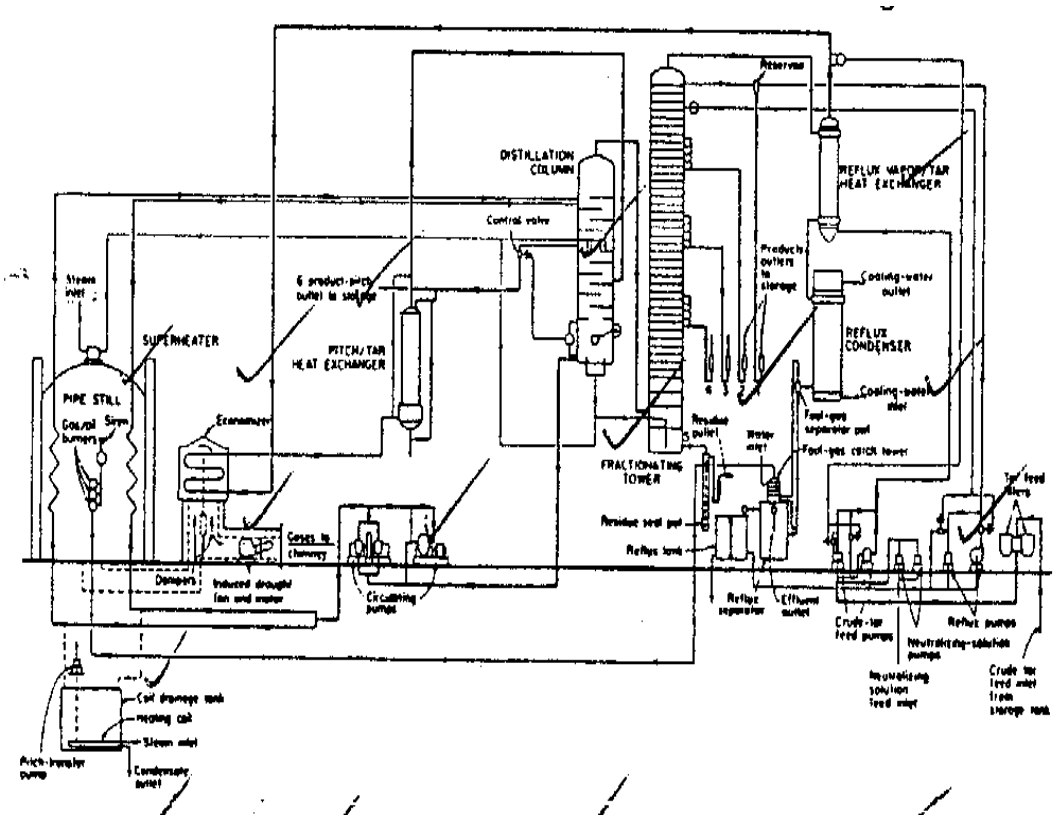
QUESTION 2

2.1
2.1.1 False
2.1.2 True
2.1.3 True
2.1.4 True
2.1.5 False

(5 × 1) (5)

2.2 LPG under a pressure of 5 bar easily condenses to a liquid, meaning that a large mass per volume energy can be stored.✓ Liquid can easily vaporise to gas.✓ It contains a flammable mixture of propane, propylene, butylene, isobutane and n-butane.✓ LPG is obtained as a by-product in oil refineries.✓ These gases are dissolved in oil, which is refined.✓ This gas-type of fuel is widely used in domestic applications and in industries such as glass industries for furnaces.✓ LPG comes from the ground as a constituent of wet natural gas or of crude oil, or as a by-product from refining.✓ (7)

2.3



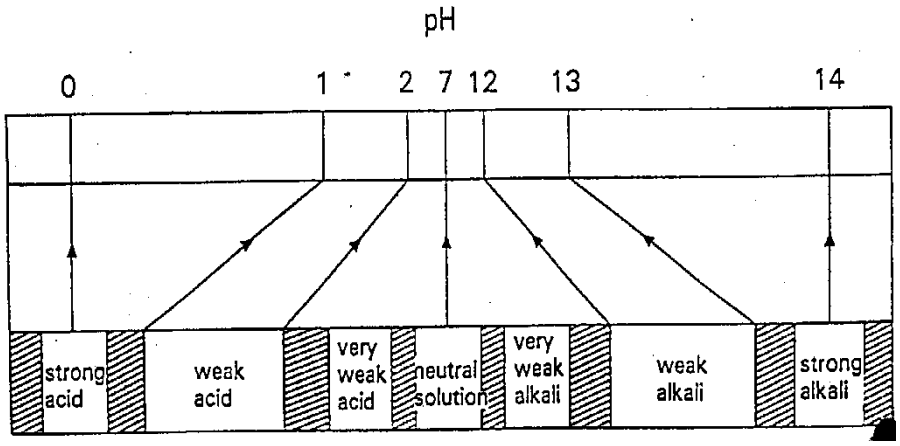
(1 mark for correct drawing and 12 marks for labels) (13)
[25]

QUESTION 3

3.1 3.1.1 An acid is a substance that increases the concentration of hydrogen/hydronium ions (H^+) in an aqueous solution✓ or that is able to donate protons to another substance.✓ When an acid dissolves in water, it breaks up (dissociates) into small particles, called ions.✓ This is the reason why acids are so corrosive.✓ (4)

3.1.2 Bases are substances that also ionise when dissolved in water, but they form hydroxide ions (^-OH).✓ A reaction of an acid and a base is known as protolysis.✓ This is the reaction during which protons are transferred in water.✓ Weak bases are $CaCO_3$ and Na_2CO_3 (carbonates) and strong bases are NaOH, $Ca(OH)_2$ and KOH (hydroxides).✓ (4)

3.2



- Strong acids ionise almost completely in a solution and have a high concentration of hydrogen ions.✓
- Weak acids ionise only partially in a solution and have a low concentration of hydrogen ions.✓

(1 mark for correct drawing, 3 marks for correct labels and 2 marks for explanation) (6)

3.3 A resin is pre-saturated with the same ions as in a solution.✓ It can reject ions in such a solution, but at the same time absorb non-ionic organic substances such as glycerine, which may also be in the solution.✓ The organic matter can later be washed from the resin in an ion-free state.✓ (3)

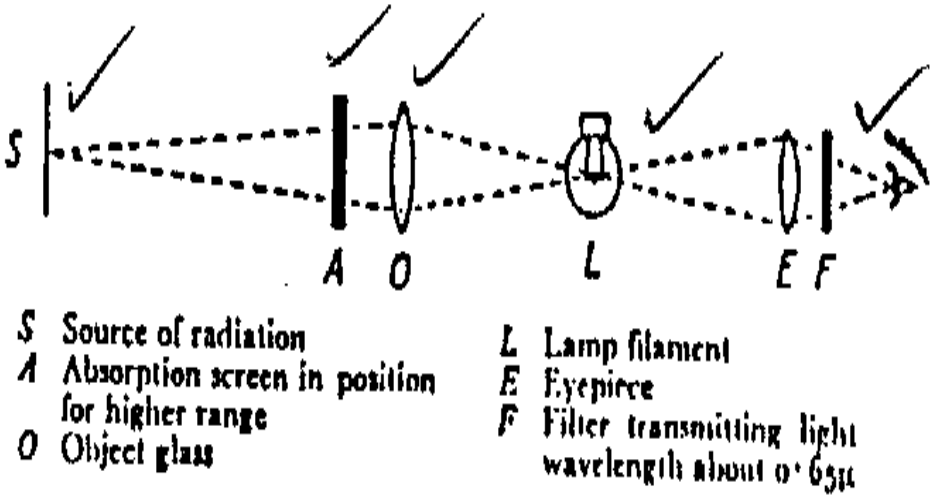
3.4
- Aqueous solutions of acids are electrolytes.
- Acids have a sour taste.
- The pH value of acids is less than 7.
- Acids turn blue litmus paper red.
- Acids react with active metals to yield hydrogen gas.
- Acids react with bases to produce a compound of salt and water.
- Acids are corrosive in nature. (Any 5 × 1) (5)

3.5 To make a purer caustic soda and to lessen clogging of the cell diaphragm with a consequent increase, purification of the NaCℓ solution of calcium, ions and magnesium compounds is practised, using soda ash with some caustic soda.✓ Sometimes sulphates are removed with BaCℓ or the hot brine is treated with hydroxyl and carbonate ions.✓ The clear brine is neutralised with hydrochloric acid.✓ (3)

[25]

QUESTION 4

4.1



- They may be divided into two groups.
- In the first group, the light of a given wavelength from the hot body is optically matched with the light from a constant comparison lamp in the instrument by means of an optical wedge or polarising system.
- In the second group, which has now become by far the most popular, the brightness of the light from the calibrated comparison lamp is varied to match the light from the hot body.
- The brightness of the lamp is judged to be the same as that of the source when it merges into the image of the source.
- The instrument is therefore known as the disappearing filament pyrometer.

(7 marks for correct and fully labelled diagram and 5 marks for explaining the operation) (12)

4.2 4.1.2

- In this instrument, the level of the measure liquid is held constant at an overflow tube.
- A glass hydrometer either rises or falls in the liquid as the specific gravity varies.
- The lower end of the hydrometer supports an armature in an inductance coil.
- A similar coil in the recording instrument duplicates any movement of this armature.
- With this system, the temperature of the liquid is usually recorded along with the value of specific gravity, so that corrections can be made. (Any 4 × 1) (4)

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4.1.3 In a thermo-electric circuit composed of two metals A and B with junctions at temperature t_1 and t_2, respectively,✓ the emf is not altered if one or both the junctions are opened and one or more other metals are interposed between the metals A and B,✓ provided that all the junctions by which the single junction at temperature t_1 may be reduced are kept at t_1,✓ and all those by which the junction at temperature t_2 may be replaced are kept at t_2.✓ (4)

4.3
- McLeod vacuum gauge
- Bourdon tube
- Barometer
- Manometer
- Helical type
- Resistance type
- Open leg U-tube
- Closed leg U-tube
- Piezometer
- Diaphragm pressure gauge (Any 5 × 1) (5)

[25]

TOTAL: 100

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