



# higher education & training

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

T330(E)(J27)T

**NATIONAL CERTIFICATE**

**CHEMICAL PLANT OPERATION N6**

(8050026)

**27 July 2018 (X-Paper)**

**09:00–12:00**

**This question paper consists of 6 pages.**

**DEPARTMENT OF HIGHER EDUCATION AND TRAINING**  
**REPUBLIC OF SOUTH AFRICA**  
NATIONAL CERTIFICATE  
CHEMICAL PLANT OPERATION N6  
TIME: 3 HOURS  
MARKS: 100

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**INSTRUCTIONS AND INFORMATION**

1. Answer ALL the questions.
  2. Read ALL the questions carefully.
  3. Number the answers according to the numbering system used in this question paper.
  4. Write neatly and legibly.
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**QUESTION 1**

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.1–1.5) in the ANSWER BOOK.

- 1.1 An adsorption operation can be used to remove contaminants from solution.
- 1.2 Dalton's law is applied to a liquid solution and to vapour in equilibrium with the solution.
- 1.3 One of the ways that heat is transferred is by conduction in which energy is transferred through air in the form of rays.
- 1.4 Crude oils vary in compounds with respect to the paraffin, naphthalene and aromatic groups.
- 1.5 A rotameter is always fitted in a horizontal position with the narrow end at the bottom.

(5 × 1)

**[5]****QUESTION 2**

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–H) next to the question number (2.1–2.5) in the ANSWER BOOK.

<b>COLUMN A</b>		<b>COLUMN B</b>	
2.1	Regarded as a gas law and only applicable to gases	A	rectification
2.2	Law stating that the vapour pressure of solvent above a solution is equal to the vapour pressure of the pure solvent at the same temperature scales multiply by the mole fraction of the solvent present	B	bimetallic strip
2.3	Actual vapour enrichment over one plate divided by the theoretical vapour enrichment which would have been obtained if the liquid on the plate and the vapour leaving the plate had reached equilibrium	C	Murphree plate efficiencies
2.4	Object that is made up of two types of metal joined together	D	mercury-in-glass thermometer
2.5	Temperature measurement instrument which can be connected to either an analogue or digital dial capable of being calibrated for temperature and converting it into mechanical movement	E	Raoult's law
		F	bimetallic thermometer
		G	q-line
		H	Dalton's law

(5 × 1)

**[5]**

**QUESTION 3**

3.1 Water that is to be softened or de-ionised is passed over beads of ion-exchange resin in a column until the resin becomes nearly saturated.

Discuss ion exchange under the following:

3.1.1 The principles of ion exchange (11)

3.1.2 Factors affecting the rate of ion exchange (5)

3.2 In a Higgins contractor the stationary upper bed of solids is contracted with liquid flowing downwards.

Make a labelled sketch of a Higgins contactor indicating the position of the piston and the valve.

(6)  
[22]

**QUESTION 4**

4.1 Weirs are mainly used to control the depth of the liquid on the tray.

Give the applications of each of the following weirs:

4.1.1 V-notch weir

4.1.2 Circular weir

4.1.3 Outlet weir (overflow)

(3 × 1) (3)

4.2 Refer to the statement in QUESTION 4.1 to answer the questions:

4.2.1 Which weir is regarded as the most common?

4.2.2 Why is an inlet weir not generally recommended?

(2 × 1) (2)

4.3 Write brief, explanatory notes on the following processes used for the purification or separation of petroleum products:

4.3.1 Filtration (4)

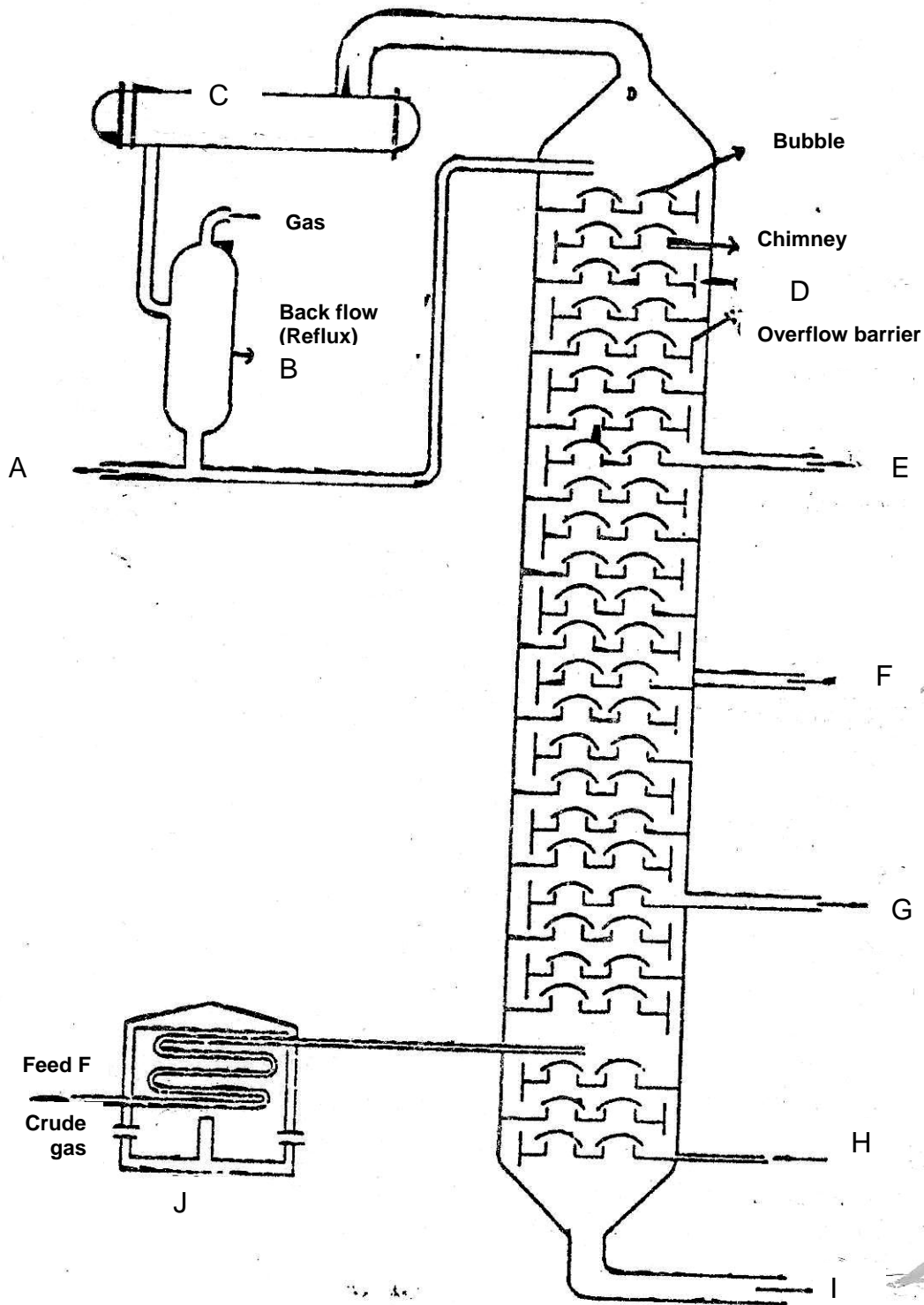
4.3.2 Crystallisation (2)

4.4 Before coal can be converted to coke, different grades of coal are blended to ensure that a good quality of coke is produced.

Name and describe TWO methods that can be used for the coking of coal. (10)

4.5 The diagram below shows a distillation tower of a crude oil that produces different types of petroleum products.

Identify the parts and products indicated by letters by writing the answer next to the letter (A–J) in the ANSWER BOOK.



(10 × 1)

(10)  
[31]

**QUESTION 5**

- 5.1 During the manufacturing of chlorine and caustic soda, chlorine is produced at the anode and hydrogen together with sodium at the cathode.

Describe the preparation of caustic soda by means of electrolysis.

Use a mercury cathode.

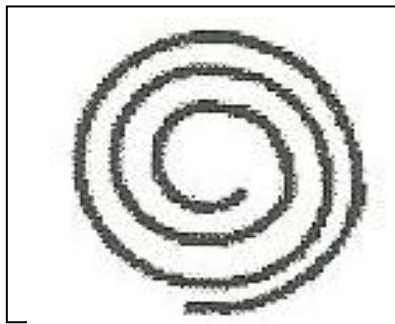
(13)

- 5.2 Bourdon tubes are circular shaped tubes with an oval cross-section used in the process industries to measure high pressures.

Discuss the operation of a C-shaped Bourdon tube.

(5)

- 5.3 Name the TWO types of Bourdon tubes shown below. Write the answer next to the question number (A–B) in the ANSWER BOOK.

**A****B**(2)  
[20]**QUESTION 6**

- 6.1 The movement of fluids (liquids and gases) between different pieces of equipment must be measured to determine how much fluid is used or moved.

Explain the operation of a positive displacement meter.

(6)

- 6.2 Name FOUR types of positive displacement meters.

(4)

- 6.3 Temperature is measured in the SI units Kelvin (K) and degree Celsius ( $^{\circ}\text{C}$ ) or in the Imperial units degrees Fahrenheit (F) and Rankine.

6.3.1 Which temperature scale designates the freezing point of water as  $32^{\circ}$ ?

6.3.2 Name the temperature scale that has the assigned value of 273,16.  
(2 × 1)

(2)

6.3.3 Describe the Celsius scale.

(2)

- 6.4 Discuss the concept pH.

(3)

[17]

**TOTAL: 100**