higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N1

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This marking guideline consists of 6 pages.

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QUESTION 1: CHEMISTRY

1.1 1.1.1
- A simpler way of indicating the valence electrons in an atom with the aid of the Lewis diagram

OR

- It shows the bonding between the atoms of a molecule and the lone pairs of electrons that may exist in the molecule.

1.1.2 The same number of electrons moves in the space surrounding the nucleus of an atom as the protons in the nucleus.

1.1.3
- They all contain seven electrons in the outer energy level and are very reactive.

OR

- They relatively easily take up one electron during a chemical reaction and then fill that energy level. They are called halogens.

(3 × 2) (6)

1.2
- They are poor conductors of heat and electricity except carbon in the form of graphite.
- Have a little lustre and do not often reflect light except carbon in the form of diamonds.
- In their solid state, nonmetals are often brittle.
- They occur in all three phases of matter, i.e. solid, gas and liquid.
- They have electronegativity.
- They have a low melting point and a low boiling point.
- They have a low density. (Any 5 × 1) (5)

1.3
1.3.1 6
1.3.2 8
1.3.3 12
1.3.4 15
1.3.5 19

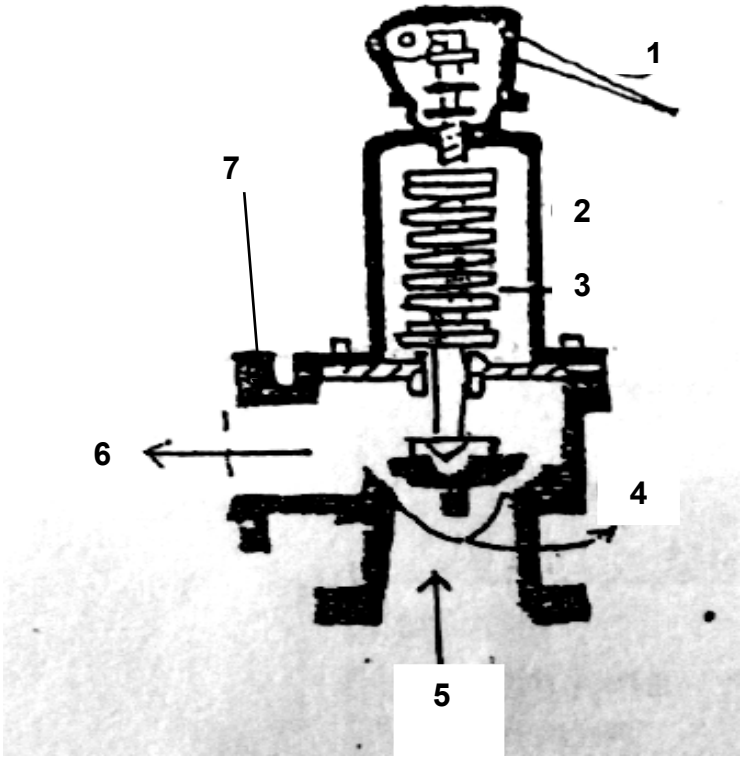
(5 × 1) (5)

1.4 Mr (1 + 35 + 23 + 16 + 1) ⟶ Mr (23 + 35 + 2 + 16)✓
36 + 40 = 58 + 18✓
76 g/mol = 76 g/mol✓✓ (4)

[20]

QUESTION 2: PIPES AND VALVES

2.1



1. Reset lever
2. Cap
3. Spring
4. Valve seating
5. From tank
6. To atmosphere
7. Body (7 × 1) (7)
(1 mark for neatness) (1)

2.2
- Nonrising shaft
- Internal screw with rising shaft
- External screw with rising shaft (3)

2.3
- Schedule 40 is for standard pipes
- Schedule 80 is for extra heavy pipe
- Schedule 160 is for double extra heavy pipes (3)

2.4
- Zinc is immersed in a zinc bath to obtain the coating in the same manner as a zinc rooting plate.
- Zinc is deposited electrolytically on carbon steel by means of electrolysis. (2)

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2.5 P = Pgh
= 998 kg/m^3 × 9,81 m/s^2 × 3 m✓
= 29 371,14 Pa✓
= 29,371 kPa✓✓ (4)
[20]

QUESTION 3: PUMPS AND INSTRUMENTATION

3.1 3.1.1 Work(f) = Force × Distance
= (2 500 × 1 000 × 9,81 × 30)✓
= 735 750 000 ÷ 10^6✓
= 735,75 MJ✓

3.1.2 Power(p) = F ÷ Time✓
= 735,75 ÷ (2 × 60 × 60) × 10^3✓
= 102,18 kW✓

3.1.3 Input = Output ÷ Efficiency✓
= 102,18 ÷ 0,4✓
= 255 45 kW ✓

(3 × 3) (9)

3.2
- pH
- conductivity
- density
- viscosity (4)

3.3
- Open the vent valves.
- Connect the vent pipe to the external water source and open all the valves.
- Slowly open the pump to let out entrapped air.
- Close the vent valves and open the main delivery.
- Switch on the pump and observe the pressure.
- As soon as the pressure is high enough, slowly open the main delivery valve.
- Take note of any vibrations during operation. (7)

[20]

QUESTION 4: DISTILLATION AND WATER TREATMENT

4.1
- Hard water
- Soft water
- Distilled water (3)

4.2
- Temporary hardness
- Permanent hardness (2)

4.3 When the resin is spent or dead due to the ion exchange process for the softening of permanent hard water, it can be redeemed as follows:✓

The tank containing Mg_2 and Ca_2 (first tank) is now treated✓ with a strong solution of sodium chloride✓ which again transfers the sodium ions to the permutit or zeolite, ready for reuse.✓

$Mg\ Z + 2NaCl = Na_2Z + MgCl_2$✓
$Ca\ Z + 2NaCl = Na_2Z + CaCl_2$✓ (6)

4.4 Given m = 50 kg
C = 390 J/kg^oC

$T = t_2 - t_1$
$= 120 - 30$
$= 90\ K$✓

$Q = mcT$
$= 50\ kg \times 390\ J/kg\ K^oC \times 90\ K$✓✓
$= 1\ 755\ 000\ J$
OR
$= 1\ 755\ kJ$✓✓ (5)

4.5 4.5.1
- Evaporation occurs as a result of heating which provides the molecules of the liquid with greater molecular movement.
- It is a process where water changes from a liquid state to a vapour state under the influence of heat.

4.5.2 Condensation takes place when the movement of the molecules of the vapour decreases as a result of cooling.

(2 × 2) (4)
[20]

QUESTION 5: STORAGE AND FIRE

5.1
- Class A – solid materials e.g. paper/wood/coal✓
  Extinguisher used✓
- Class B – gases and fumes of liquid e.g. oil✓
  Extinguished by using dry chemicals/liquids/(CO_2) foams✓
- Class C – material to be burned is an electrical fire/installation component parts✓
  Extinguish with CO_2 dry chemicals✓
- Class D – material to be burned is sodium✓
  Extinguish with dry powder fire extinguisher/dry sand ✓ (4 × 2) (8)

5.2 5.2.1 They are used for high volatile hydrocarbons or in gaseous form at atmospheric pressure and temperature. (2)

5.2.2 Advantages
- Substances are under pressure and are easily transported with a pipeline.
- No fluid loss occurs to evaporation.
- Gases under pressure and substances in liquid form rather than in gas form, occupy less space.

Disadvantages
- Pressure and temperature must be controlled throughout.
- Storage in high pressure, durable resistance containers are required.
- Fire risk is higher.

(2 × 3) (6)

5.3
- Gloves
- Coats/laboratory coats
- Aprons
- Safety shoes (4)

[20]

TOTAL: 100

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