higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

REFRIGERATION TRADE THEORY N3

5 NOVEMBER 2018

This marking guideline consists of 6 pages

QUESTION 1

1.1 1.1.1 Sub cooled liquid

1.1.2 Liquid-vapor mixture

1.1.3 Saturated vapor

1.1.4 Superheated vapor

1.1.5 Liquid-vapor mixture (5)

1.2.1 A superheated vapour is vapour is a vapour in such a condition that if some were removed from it, the volume of the vapour would decrease, but there would be no condensation. (3)

1.2.2 A saturated vapour is a gaseous substance in such condition that if some heat were removed from it, the volume of the vapour would decrease and there would be condensation. (3)

1.3 Absolute pressure = Gauge pressure + atmospheric pressure
=725 + 101,4 = 826.4 K Pa✓ (1)

1.4 Gauge pressure = Absolute pressure – atmospheric pressure
= 850 -101,4= 748,6 K Pa✓ (1)

1.5 $℃ = K - 273$
= 330 – 273 = 57 ℃ ✓ (1)

1.6 K = $℃ + 273$
= -270 + 273 =543 k✓ (1)

1.7 $℃ = \frac{5}{9} \times (℉ - 32)$
$= \frac{5}{9} \times (88 - 32) = 31{,}1\ ℃$✓ (1)

1.8
- Time.
- Temperature difference.
- Thickness of the isolation material.
- Type of isolation material.
- External surface area of the cabinet. (Any 4 × 1) (4)

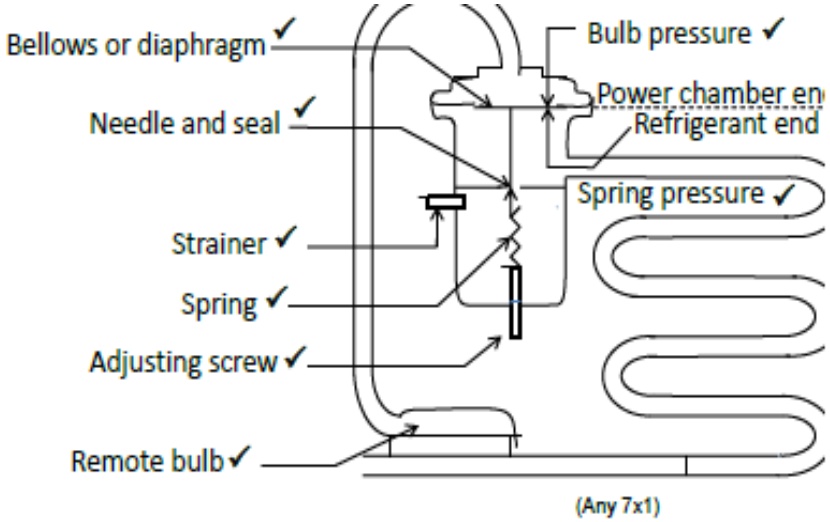
[20]

QUESTION 2

2.1
- Automatic expansion valve.
- Thermostatic expansion valve
- Capillary tube.
- Low-side float.
- High-side float.

(5)

2.2



(Any 7x1) (7)

2.3
- If the head pressure increases, the amount pumped per stroke will decrease.
- If the low side pressure decreases, it is more difficult for the vapour to fill the cylinder, and the amount pumped per stroke will decrease.
- If the clearance space is enlarged the amount pumped per stroke will decrease.
- The size of the valve openings. The smaller it opens, the less vapour will be passed through. (Any 3 × 2) (6)

2.4 To lubricate the moving parts in mechanical refrigeration systems for long life and efficient performance. (1 × 2) (2)

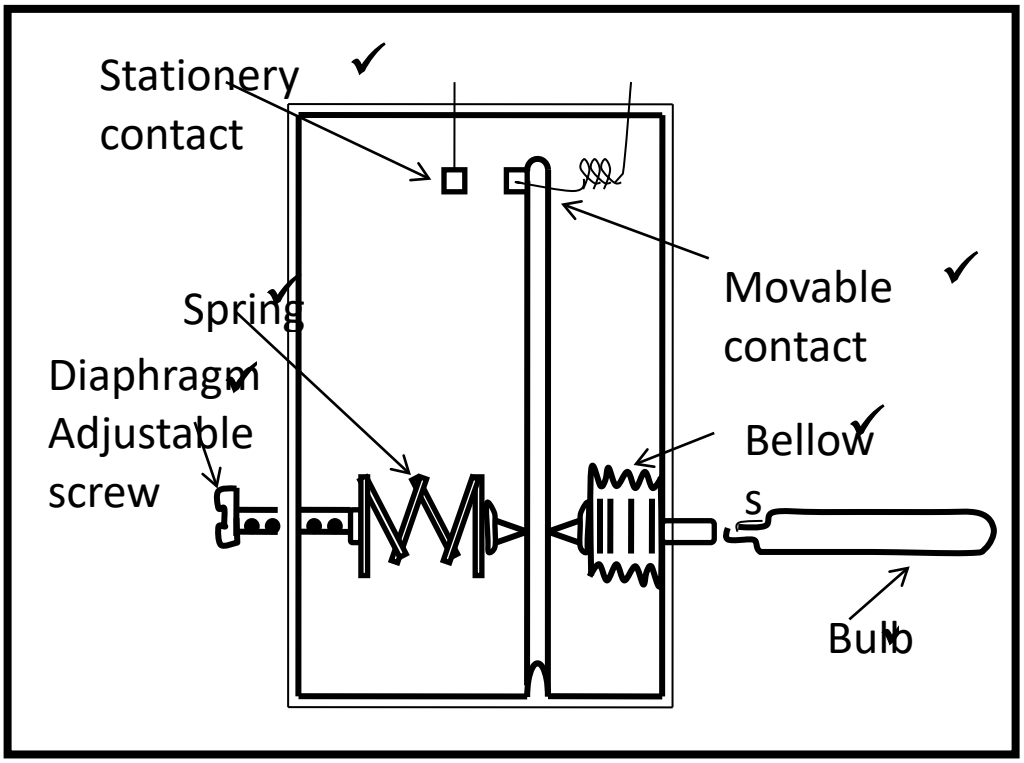
[20]

QUESTION 3

3.1 3.1.1 The value at which the controlled variable is maintained✓ and recorded by the control. ✓ (2)

3.1.2 A device which measures the value of the controlled variable✓and converts the information into a signal that can be used by the Control System.✓ (2)

3.2



(6)

3.3 $Vp=\frac{\pi D^2 SNR}{4}$

$=\frac{3,142\times(0,08)^2\times0,088\times8\times20}{4}$ ✓

$=0,0708\ m^3/s$ ✓

$\eta=\frac{V}{VP}$ ✓

$=\frac{0,225}{0,078}\times\frac{100}{1}$ ✓

$=31,8\%$ ✓ (5)

3.4 3.4.1 Shell-and –tube condenser (1)

3.4.2 Shell-and-coil condenser (1)

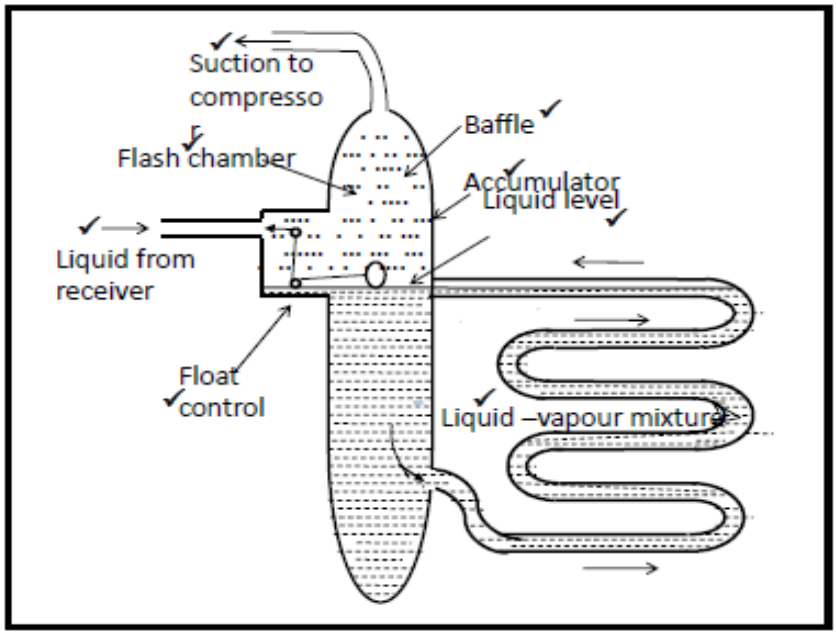
3.5 The condensed water is circulated through the coil and the refrigerant is contained in the shell. ✓ Refrigerant vapour enters at the top, condenses on the cold coils✓ and liquid drains off into the bottom of the shell. ✓ (3)
[20]

QUESTION 4

4.1 4.1.1 Defrost has a large area which will maintain the required room temperature✓. During the running of the compressor, the evaporator will remain at temperature between -5℃ ✓and -10℃✓. (3)

4.1.2 Non-frosting operates at temperatures which do not go much below 0℃ and ice✓ cannot build up✓. Occasionally, the evaporator may build up a light coat of frost just before the compressor shuts off✓. (3)

4.2



(6 × 1) (6)

4.3
- The friction loss must be as low as possible.
- The valve must open with the least possible pressure difference.
- The valve must close quickly to avoid back leakage.
- The valve must not increase the clearance volume. (4 × 2) (8)

[20]

QUESTION 5

5.1 The ratio of the heat absorbed in the refrigerated space to the heat energy equivalent of the energy supplied to the compressor. (2)

5.2 5.2.1 Mass flow rate $= \frac{load}{Re}$

$= \frac{30}{145}$ ✓

$= 0.207 \text{ kg/s}$ ✓

5.2.2 The work of compression

$WD = \frac{Re}{COD}$

$= \frac{145}{4.9}$ ✓

$= 29.59 \text{ kJ/kg}$ ✓ (2)

5.2.3 Power = $\frac{WD \times \dot{m}}{\eta}$

$= \frac{29,59 \times 0,207}{0.9}$ ✓

$= 6.81 \text{ KW}$ ✓ (2)

5.3 5.3.1 The compressor compresses the saturated vapour leaving the evaporator

5.3.2 Constant pressure de-superheating and condensation

5.3.3 Expansion or throttling at constant enthalpy

5.3.4 Evaporation at constant pressure with an increase in enthalpy

(4 × 2) (8)

5.4 5.4.1 LP/HP control switch (1)

5.4.2 Thermostat (1)

5.5 A thermostat is an instrument that sense the temperature of a fluid (air or water etc.) compares it with the required temperature and takes the appropriate action i.e., switch on or off . (1 × 2) (2)

[20]

TOTAL: 100

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