higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

REFRIGERATION TRADE THEORY N3

5 APRIL 2018

This marking guideline consists of 6 pages.

Copyright reserved

QUESTION 1

1.1
1.1.1 A
1.1.2 C
1.1.3 B
1.1.4 D
1.1.5 C
1.1.6 D
1.1.7 D
1.1.8 B
1.1.9 C
1.1.10 A

(10 × 1) (10)

1.2
A – Sub-cooled liquid
B – Critical point
C – Liquid and vapour mixture
D – Absolute pressure kPa
E – Specific enthalpy – kJ/kg
F – Vapour to liquid
G – Liquid to vapour
H – Superheated vapour
I – Saturated liquid line
J – Saturated vapour line (10)

[20]

QUESTION 2

2.1
2.1.1 – Valve (Globe valve)✓
A valve is a mechanical device that blocks a pipe, either partially or completely, to change the amount of fluid that passes through it.✓✓

2.1.2 – Strainer✓
A strainer is a mechanical device designed to help protect the system from the harmful or undesirable effects of both solid and fluid impurities. A strainer filters out solid debris in the water system. ✓✓

2.1.3– Union ✓
A pipe union is a secure and semi-permanent connection between two pipes or is used to connect two pipes together semi-permanently. ✓✓ (3 × 3) (9)

2.2
2.2.1 Reciprocating compressor (1)

2.2.2
A – Cylinder
B – Piston
C – Connecting rod
D – Crankshaft
E – Discharge valve r
F – Suction valve r (6)

2.3
- Plastic pipes are light in weight, tough, resistant to chemical attack and available in long lengths.
- They reduce the cost of handling, transportation and installation.
- Smaller number of joints facilitates the speed and reduces chances of leakage.
- They are rust-resistant.
- These pipes have good elastic properties.
- Their adaptability to earth movements is superior.
- Smooth internal surface of the pipes offers less friction.
- Less friction saves energy in the conveyance of water.

(Any 4 × 1) (4)
[20]

QUESTION 3

3.1 3.1.1 Sub-cooling in refrigeration means cooling the refrigerant in a liquid state, at uniform pressure, to a temperature that is less than the saturation temperature, which corresponds to condenser pressure.

3.1.2 Superheating is when liquid refrigerant enters an evaporator and is entirely vaporised before it arrives at the outlet of the evaporator. The liquid is vaporised at a low temperature, while the vapour is cold after the liquid has been totally evaporated. As the cold vapour flows though the evaporator, it continues to absorb heat, and becomes superheated. As the vapour becomes superheated, it absorbs sensible heat in the evaporator.

3.1.3 The volumetric efficiency (V) of a compressor is defined as the ratio of the actual volume of gas sucked by it to the theoretical volume that it could have sucked if the clearance volume was not present.

3.1.4 The compression ratio, R, of the reciprocating compressor is defined as the ratio of the suction pressure of the refrigerant to the discharge pressure of the refrigerant.

(Any relevant 4 × 2) (8)

3.2 The current-type relay has normally open (NO) contacts. ✓
The coil of the relay is connected in series with the running windings of the compressor motor. ✓
When the power is switched on, the running winding will draw a very high current because the motor is not rotating. ✓
This high current is also flowing through the relay coil, causing a high magnetic field closing the relay contact point, bringing in the starting winding. ✓✓
The motor starts to rotate, thus there is a decrease in the high current in this running coil and the relay coil. ✓
The strong magnetic field reduces in the relay coil, and the contact points of the relay open, cutting the starting winding out of the system. ✓

(Any relevant 7 ×1) (7)

3.3 $$VP = \frac{\Pi D^2 S N R}{4}$$

$$VP = \frac{3{,}142 \times (0{,}03)^2 \times 0{,}07\,x\,6\,x\,20}{4}$$

$$VP = 0{,}005\ m^3/s \rightarrow$$

$$\eta = \frac{V}{VP}$$

$$\eta = \frac{0{,}0043}{0{,}005} \times \frac{100}{1}$$

$$\eta = 86\% \rightarrow$$ (5)

[20]

QUESTION 4

4.1
- Regulation of air quantity
- Recirculation of air
- Flooding condenser with refrigerant
- Regulating water temperature or water quantity (4)

4.2 ADVANTAGES
- Higher COP in flooded systems
- Better flow distribution into evaporator because the inlet is 100% liquid
- Better utilisation of plate area, because there is no superheating zone
- The flooded evaporator is self-regulating (Any relevant 2 × 1) (2)

DISADVANTAGES
- Higher installation cost, because more equipment is needed (receiver, more pipes)
- More refrigerant is needed to avoid superheating in the evaporator
- Is more important with a low pressure drop in the evaporator, because it is driven by density differences
- More difficult to design, because the system is sensitive to deviations from the calculated refrigerant flows (Any relevant 2 × 1) (2)

4.3 The heat exchanger is a device used to transfer heat from the liquid refrigerant to the suction gas. Any device which brings into contact two substances of different temperatures for the purpose of heating or cooling one of these substances is called a heat exchanger. ✓

In refrigeration, the heat exchanger brings the liquid refrigerant and suction gas into thermal contact with each other. ✓
The reduction in temperature is necessary in systems that have high pressure drops to prevent flashing in the liquid line. These pressure drops may be caused by excessively long lines or by lengthy liquid risers. ✓
Secondly, the exchanger has to ensure that the suction gas flowing into the compressor is dry. ✓ (Any relevant 4 × 1) (4)

Where to install:
The selection and location of the heat exchanger will depend on its intended usage. If the heat exchanger is being used for the purpose of sub-cooling the liquid, it will be found as close to the condenser as possible. ✓
A heat exchanger that is being used as protection against slipover may be mounted in the suction line quite close to the evaporator. ✓

(Any relevant 2 × 1) (2)

4.4
- The evaporator must have a large enough surface area to absorb the heat load
- without irregular temperature differences between the refrigerant and the substance to be cooled.
- The evaporator must provide sufficient space for the liquid refrigerant
- as well as sufficient space for the refrigerant vapour to part from the liquid.
- The evaporator must provide sufficient space for the circulation of the refrigerant
- without an irregular pressure drop between the inlet and the outlet.

(Any relevant 6 ×1) (6)
[20]

QUESTION 5

5.1
5.1.1 False
5.1.2 True
5.1.3 True
5.1.4 True
5.1.5 False

(5 × 1) (5)

5.2 5.2.1 Flash gas is refrigerant in gas form, produced spontaneously when the condensed liquid is subjected to boiling or when its boiling temperature is reached whilst in the piping. (2)

5.2.2 Sub-cooling and superheating (2)

5.2.3 It reduces refrigeration efficiency or the cooling effect (1)

5.3 5.3.1 Anti-vibration spring mounting (1)

5.3.2 Elimination of vibration (1)

5.3.3
- Imbalanced rotating shafts
- Misaligned shafts
- Worn bearings, gears and drive belts etc
- Loose bearings

(Any relevant 4 ×1) (4)

5.4
- Check lubrication oil level. If there is discoloration/ contamination drain and replace with new oil
- Drain receiver tank
- Do an overall visual inspection and make sure all guards are secured
- Check lubricant leaks
- Check for unusual noise and vibrations
- Check for air leaks (4)
- Inspect air filter (Any 4×1) **[20]**

TOTAL: 100

Copyright reserved