higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

REFRIGERATION TRADE THEORY N3

23 November 2022

This marking guideline consists of 5 pages.

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QUESTION 1

1.1
1.1.1 False
1.1.2 False
1.1.3 True
1.1.4 False
1.1.5 True
1.1.6 True
1.1.7 False
1.1.8 True
1.1.9 False
1.1.10 True

(10 × 1) (10)

1.2 1.2.1 In a compound system, two or more compressors are connected in series. Compressor 1 discharges into the intake side of compressor 2. Here it discharges into the condenser. An oil separator is usually required for each compressor to ensure oil return to the compressor. (Any other 1 × 4) (4)

1.2.2 The cascade system consists of two or more refrigerating systems. Each system operates at the same time. In the first system, the evaporator is arranged in such a manner as to cool the condenser of the second system. The second evaporator supplies the cooling effect desired. Each system has its own thermostatic expansion valve for control of the refrigerant. The refrigerant must be very dry (free from moisture). Oil separators should be installed between the compressor and condenser lines in all the systems.

(Any other 1 × 6) (6)
[20]

QUESTION 2

2.1 A –Globe valve
B – Butterfly valve (2)

2.2 2.2.1 A valve is a mechanical device that blocks a pipe, either partially or completely, to change the amount of fluid that passes through it

(Any other 1 × 2) (2)

2.2.2 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. (Any other 1 × 2) (2)

2.2.3 An air vent in a pipeline system is used to release accumulated air that comes out of a solution within a pressurised pipeline.

(Any other 1 × 2) (2)

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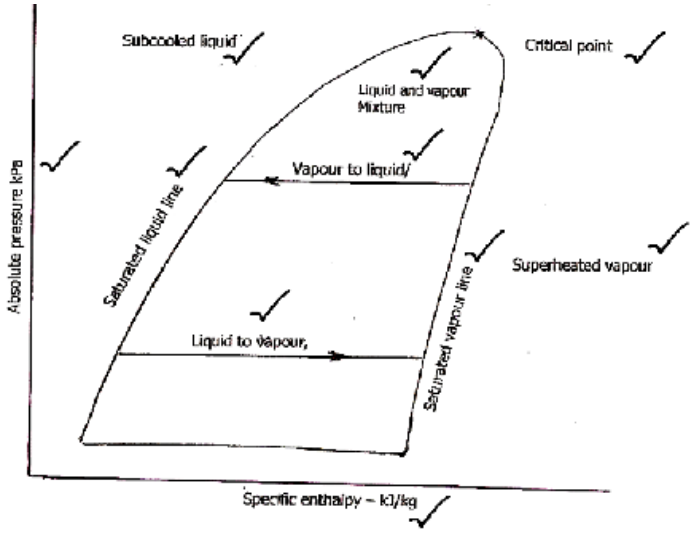
2.2.4 An expansion tank or expansion vessel is a small tank used to protect closed (not open to atmospheric pressure) water heating systems and domestic hot water systems from excessive pressure.
(Any other 1 × 2) (2)

2.3



PRESSURE ENTHALPY (P-H) DIAGRAM

(10)
[20]

QUESTION 3

3.1
- Starting and stopping the compressor
- Changing the speed of the compressor
- Lifting of the suction valves
- Hot-gas bypass
- Regulating the suction pressure
- Regulating the discharge pressure

(Any other 4 × 2) (8)

3.2
- No shaft seal required
- Compressor mounting is easy
- No shaft-alignment problems
- Correct amount of lubricating oil in compressor

(Any other 3 × 1) (3)

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

$$VP = \frac{\pi \times (0{,}08)^2 \times 0{,}09 \times 8 \times 14}{4}$$

$$VP = 0{,}05075\ m^3/s$$

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

$$= \frac{0{,}0225}{0{,}05075} \times 100$$

(5)

$= 44{,}3\ \%$

3.4

COMPRESSION SYSTEM	ABSORPTION SYSTEM
• Uses mechanical energy • Uses electrical motor • Motor has moving parts • Motor is sometimes not quiet • Must have an electricity supply	• Uses heat energy • Uses gas or heating element • Minimum moving parts • Quiet while in operation • Operates on small gas cylinder (Any other 2 × 2)

(4)

3.5
- Splashed feed
- Pump-forced feed

(2)

3.6 To crack a service valve: It means you front seat the valve, and then turn it back a quarter of a turn. On the back seat it is the same procedure.

(Any other 1 × 2) (2)

[24]

QUESTION 4

4.1
- Lubricate moving parts with a thin film of oil to minimise friction and prevent wear.
- Create a fluid seal.
- Act as coolant in compressor.
- Dampen noise in compressor crankcase. (Any other 4 × 1) (4)

4.2 Advantage:
The inside of the pipes is completely wetted with refrigerant and produces a very high rate of heat transfer. (2)

4.3 The expansion valve provides a pressure-reducing point between the condenser and evaporator and passes the correct amount of refrigerant into the evaporator. (Any other 1 × 2) (2)

4.4 An evaporative condenser consists of an air-cooled condenser over which water is allowed to flow. The air blast from the fan causes the water to evaporate from the surface of the condenser fins, absorbing heat from the refrigerant in the evaporation process. The water, which is exposed to the air flow, evaporates very rapidly. The latent heat required for the evaporating process is obtained by a reduction in sensible heat, therefore a reduction in the temperature of the remaining water. The hot refrigerant vapour is piped through a spray chamber where it is cooled by evaporation of the water coming in contact with the refrigerant tubing. Since the cooling is accomplished by evaporation of water, water is only a fraction of that used in conventional water-cooled condensers. (Any other 8 × 1) (8)

[16]

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

$$mass\ flow\ rate = \frac{load}{Re}$$

$$= \frac{45}{149}$$

$$= 0{,}302\ kg/s$$ (2)

5.2.2

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

$$= \frac{149}{5{,}4}$$

$$= 27{,}59\ kJ/kg$$ (2)

5.2.3

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

$$= \frac{27{,}59 \times 0{,}302}{0{,}85}$$

$$= 9{,}8\ kW$$ (2)

5.3
- Shut the service valve.
- Connect the system analyser with blue on the low-pressure side and the red on the high-pressure side.
- Block the high- and low-pressure connections.
- Crack the suction valve, and switch on the compressor.
- If pressure on the high side is too low, then allow gas to flow into the low side of the compressor and switch off.
- Check for leaks on the high side as well as the low side.
- Allow the gas to escape and repeat step 5.
- Note the reading and switch off the compressor.
- Check readings again after 15 minutes.
- If readings are still the same, it can be assumed that the compressor is 100% efficient.
- If there is a difference of more than 30%, the compressor is not suitable.
- The cause is normally leaky valves which must be repaired.

(Any other 12 × 1) (12)
[20]

TOTAL: 100

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