higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

REFRIGERATION TRADE THEORY N3

28 November 2024

This marking guideline consists of 6 pages.

Copyright reserved

QUESTION 1

1.1 1.1.1 Vapour formed at constant saturation temperature and pressure√ until the dryness fraction of 1 is reached. √

1.1.2 Vapour formed above the saturation temperature and pressure√ when heat is added√.

1.1.3 Amount of heat added or released to change the temperature of 1 kg√ of a substance by one degree (Celsius or kelvin) √

(3 × 2) (6)

1.2 Miscellaneous heat load in refrigeration refers to the additional heat√ energy that enters the refrigerated space from various sources beyond the primary cooling load√. These sources can include people√, lighting√, equipment√, infiltration√ and product heat√. (5)

1.3
- Condenser surface area√
- Type of cooling medium√
- Type of material used in tubing√
- Thickness of tubing√
- Temperature√ (5)

1.4 Sublimation√ (1)

1.5
- Entering wet-bulb temperature√
- Air flow rate√
- Water flow rate √

(3)
[20]

QUESTION 2

2.1 2.1.1 Crankcase pressure regulator√ (1)

2.1.2 A: Spring force√
B: Adjusting spring√
C: Inlet√
D: Access valve√
E: Outlet√
F: Seat disc√
G: Bellows√ (7 × 1) (7)

2.1.3
- Compressor√
- Evaporator√ (2)

2.2 2.2.1 A device that measures the value of the controlled variable√ and converts the information into a signal√ that can be used by the control system√ (3)

2.2.2 A device that receives a signal from the controller√ and changes it into corrective action√ (2)

2.3 $$V_p = \frac{\pi \times D^2 \times S \times N \times R}{4}$$

$$= \frac{3{,}142 \times (0{,}07)^2 \times 0{,}08 \times 8 \times 10}{4}\sqrt{}$$

$$= 0.02463\ \mathrm{m^3/s}\sqrt{}$$

$$\eta = \frac{0{,}0225\sqrt{}}{0{,}02463\sqrt{}} \times 100$$

$$= 91.35\%\sqrt{}$$ (5)

[20]

QUESTION 3

3.1

COMPRESSION SYSTEM	ABSORPTION SYSTEM
• Uses mechanical energy√	• Uses heat energy√
• Uses electrical motor√	• Uses gas on heating element√
• Moving parts√	• Minimum moving parts√
• Sometimes not quiet√	• Quiet while in operation√
• Must have an electricity supply√	• Operates on a small cylinder√

(Any 5 × 1) (5)

3.2 In a refrigeration system, "flash gas" refers to the sudden vaporization of liquid refrigerant into gas√ when it expands rapidly, typically through a valve√ or orifice. This occurs when high-pressure liquid refrigerant enters a low-pressure area, causing the liquid to rapidly change state to gas√. (3)

3.3
- A vibration absorber reduces the transmission of the compressor's vibrations to the refrigerating system pipes√. Minimize the risk of vibration-induced damage, noise, and stress on the system√
- It is installed in the discharge line near the outlet and suction line near the inlet of the compressor√ and on other vibrating components, such as pumps and motors, or valves. √

(2 × 2) (4)

3.4
- Overfeeding the evaporator leading to reduced cooling capacity. √
- Overfeeding leading to compressor flooded start. √
- Increase pressure difference leading to high energy consumption. √ (3)

3.5 3.5.1 $$\text{Mass flow} = \frac{\text{load}}{R_e}$$

$$= \frac{55}{140} \surd$$

$$= 0{,}393 \text{ kg/s} \surd$$

3.5.2 $$\text{WD} = \frac{R_e}{\text{COP}}$$

$$= \frac{140}{4{,}8} \surd$$

$$= 29{,}167 \text{ kJ/kg} \surd$$

(2 × 2) (4)

3.6 B √ (1)
[20]

QUESTION 4

4.1 4.1.1 D √
4.1.2 E √
4.1.3 B √
4.1.4 F √
4.1.5 G √
4.1.6 A √
4.1.7 C √

(7 × 1) (7)

4.2
- To lubricate moving parts by a thin film of oil to minimise friction and prevent wear√
- To create a fluid seal√
- To act as a coolant in the compressor√
- To dampen noise in the compressor crankcase √
- Refrigerant oils circulate through the system, picking up contaminants and debris, and carrying them to the filter, helping to keep the system clean. √

(Any 4 x 1) (4)

4.3

Possible causes	Corrective measures
• Improperly wired√ • Low voltage to the unit√ • Relay failing to open√ • Run capacitor defective • Excessively high discharge pressure√ • Compressor motor has a winding open or shorted√ • Internal mechanical trouble in compressor (tight) √	• Check wiring against diagram. • Determine reason and correct. • Determine reason and correct or replace if necessary. • Determine reason and replace. • Check discharge shut-off valve, possible overcharge or insufficient cooling on √condenser. • Replace compressor. • Replace compressor.

(Any matching 3 × 2) (6)

4.4 4.4.1 Thermostat√
4.4.2 Thermometer√
4.4.3 Differential adjustment√

(3 × 1) (3)
[20]

QUESTION 5

5.1
- Shell type√
- Wall type√
- Finned tube type√

(3)

5.2 A flooded evaporator is designed to have a constant level of liquid refrigerant within the evaporator. √ Liquid enters the evaporator through a float-type expansion valve√ and flows through the tube by the gravity force√. As the liquid rises in the tubes√, heat from the outside causes the liquid to boil and a mixture of liquid and vapour bubbles from the tube into the surge drum√. The surge drum separates the liquid from the vapour as the liquid is in contact with the evaporator coil surface during normal operations. √ (6)

5.3 A screw compressor consists of two special helical rotors that are male and female rotors√. The male rotor is driven by the motor, which has four lobes that are semicircular in profile. √ The female rotor meshes with and is driven by the male rotor. √ (3)

5.4
- Pipes must be clean. √
- All joints must be free from the leaks. √
- Run all pipelines in as simple and direct manner as possible. √
- Use the minimum number of fittings. √
- Pitch the horizontal lines in the direction of the refrigerant flow. √
- The pitch should be 15 mm per 3 m of run. √

(Any 5 × 1) (5)

Copyright reserved

5.5 The air circulation inside the cold room is achieved by the axial fan√ and draws the air through the cooling coil. √ (2)

5.6
- Chill room√
- Process room√
- Quick-freezer room√ (Any ONE) (1)

[20]

TOTAL: 100

Copyright reserved