higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

REFRIGERATION TRADE THEORY N3

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This marking guideline consists of 6 pages.

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QUESTION 1

1.1	1.1.1	False		
	1.1.2	True		
	1.1.3	True		
	1.1.4	False		
	1.1.5	True		
			(5 × 1)	(5)
1.2	1.2.1	Centrifugal pump		(1)
	1.2.2	A – Closed impeller B – Semi-open impeller C – Open impeller	(3 × 2)	(3)
1.3	1.3.1	A		
	1.3.2	C		
	1.3.3	B		(3)
1.4	1.4.1	Expansion tank		(2)
	1.4.2	Strainer		(2)
	1.4.3	Air-vent		(2)
	1.4.4	Valve		(2)
1.5	• Globe • Butterfly • Gate		(Any relevant 2 × 1)	(2)
				[22]

QUESTION 2

2.1 2.1.1 Compressor discharge pressure (1)

2.1.2 (a) Hot-gas bypass means the hot discharged gas is bypassed back✓ into the suction side of the compressor when✓ the suction pressure falls below a predetermined minimum value.✓

(Any relevant 3 × 1) (3)

(b) Cylinder unloading means the suction valve of one or more cylinders is held open✓ so that gas is pumped into and back out of the cylinder through the valve without being compressed.✓ If this is done, the piston, on its downstroke, will suck vapour which on the upstroke will be expelled again into the suction system.✓ (Any relevant 3 × 1) (3)

2.1.3
- Speed control ✓✓
- stopping and starting (on/off cycling)
- Regulating suction or discharge pressure (Any 1 × 2) (2)

2.1.4 Reciprocating compressor (1)

2.2
1. Evaporation: A liquid refrigerant evaporates in a low partial-pressure environment, thus extracting heat from its surroundings (for example the refrigerator's compartment). Because of the low partial-pressure the temperature needed for evaporation is also low.✓✓
2. Absorption: The now gaseous refrigerant is absorbed by another liquid (for example a salt solution).✓✓
3. Regeneration: The refrigerant-saturated liquid is heated, causing the refrigerant to evaporate.✓ The hot gaseous refrigerant passes through a heat exchanger, transferring its heat outside the system (such as to surrounding ambient-temperature air), and condenses. The condensed (liquid) refrigerant supplies the evaporation phase.✓ (Any relevant 3 × 2) (6)

2.3
- No moving parts hence cheap to maintain✓✓
- No compression hence less power requirements✓✓(Any relevant 2 × 2) (4)

[20]

QUESTION 3

3.1 3.1.1 A cooling tower is a heat rejection device that rejects waste heat into the atmosphere✓ through the cooling of a water stream to a lower temperature.✓ (Any relevant 2 × 1) (2)

3.1.2 Induced-draft cooling tower (1)

3.1.3
- No energy consumption of fans
- Low cost of maintenance and spare parts (Any relevant 1 × 2) (2)

3.1.4
- Occupies more space
- Less efficient (Any relevant 1 × 2) (2)

3.1.5
- Regulating air quantity
- Regulating water quantity (Any relevant 1 × 2) (2)

3.2 3.2.1 An evaporator pressure regulator is mounted in the suction line of refrigeration and air-conditioning system.✓ An evaporator pressure regulator is used to maintain a constant pressure corresponding to a constant temperature on the evaporator.✓ They also protect against too low an evaporating pressure by throttling down when pressure falls below the set value.✓ They are also used to differentiate the evaporating pressures in two or more evaporators in systems with one compressor.✓ (Any relevant 4 × 1) (4)

3.2.2 A check valve or nonreturn valve or one-way✓ valve is a valve that normally allows fluid (liquid or gas) to flow through it in only one direction.✓ Check valves are two-port valves, meaning they have two openings in the body,✓ one for fluid to enter and the other for fluid to leave.✓ (Any relevant 4 × 1) (4)

3.3
- Bad distribution of air circulation causes uneven temperature✓ and dead spots✓ in the cold room.✓
- Uneven distribution over the evaporator surface lowers evaporation capacity✓ and can be the start of frosting✓ up of the coil when air velocity is low.✓ (Any relevant 1 × 3) (3)

[20]

QUESTION 4

4.1 4.1.1 Flash-gas is refrigerant in gas form produced spontaneously✓ when the condensed refrigerant liquid is subjected to boiling✓ or when its boiling temperature is reached whilst in the piping.✓ (3)

4.2 4.2.1

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

$$VP = \frac{3{,}142\,x\,(0{,}03)^2\,x\,0{,}05\,x\,4\,x\,20}{4} \checkmark\checkmark$$

$$VP = 0{,}0028278\ \mathrm{m^3/s} \rightarrow \checkmark$$

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

$$\eta = \frac{0{,}0025}{0{,}0028278}\ \mathrm{x}\ \frac{100}{1} \checkmark$$

$$\eta = 88{,}4\% \rightarrow \checkmark$$ (6)

4.2.2 Clearance volume = VP – V
= 0,0028278 – 0,0025✓
= 0,0003278 m^3/s✓ (2)

4.2.3 $\text{Compression ratio} = \frac{\text{Outlet Pressure}}{\text{Inlet Pressure}}$ ✓

$\text{Compression ratio} = \frac{1500}{250}$ ✓

$\text{Compression ratio} = 6 \rightarrow$✓ (3)

4.3
- Low weight, easy to design and to manufacture
- Suitable for continuous compressed air supply, such as cooling unit.
- Fewer rubbing parts
- High flow rate
- Relatively energy efficient
- Wide range of rotational speed
- Reliable, low maintenance
- Generating a higher pressure ratio per stage as compared to axial flow compressor.
- Does not require special foundation (Any 3 × 2) (6)

[20]

QUESTION 5

5.1 5.1.1 E = Adjustment screw
F = Adjustment spring
G = Diaphragm
H = Push rod
I = Needle and seat (5)

5.1.2
- Thermostatic expansion valve
- Float valve (2)

5.1.3
- AC system performing worse than usual and blowing warm air
- Frost on AC evaporator or coming from the vents
- AC compressor constantly running (3)

5.2
- Be certain pressure relief valves are working.
- Clean the cooling surfaces of the intercooler and compressor.
- Check the compressor for air leaks.
- Check the compressed air distribution system for leaks.
- Inspect lubricant for contamination and change if necessary.
- Clean or replace the air intake filter. Check more often under humid or dusty conditions. (Any 3 × 2) (6)

5.3
- The filter drier consists of a cylinder filled with a chemical which absorbs the moisture from the refrigerant flowing through it and catches up impurities. (Any relevant ONE) (1)

5.4
- It is fitted in the liquid line. (1)

[18]

TOTAL: 100

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