higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# MARKING GUIDELINE

## NATIONAL CERTIFICATE

## REFRIGERATION TRADE THEORY N3

**31 JULY 2018**

**This marking guideline consists of 6 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 In a compound system two or more compressors are connected in series. ✓ Compressor 1 discharges into the intake side of compressor 2✓ and from here discharges into the condenser✓. An oil separator is usually required for each compressor to ensure oil return to the compressor. ✓

(Any relevant 4 × 1) (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 relevant 6 × 1) (6)

**[20]**

## QUESTION 2

2.1
A: Compressor service valve
B: Heat exchanger
C: Refrigerant liquid accumulator
D: Compressor shaft or shaft seal
E: Oil separator
F: Filter drier
G: Vibration eliminator

(7)

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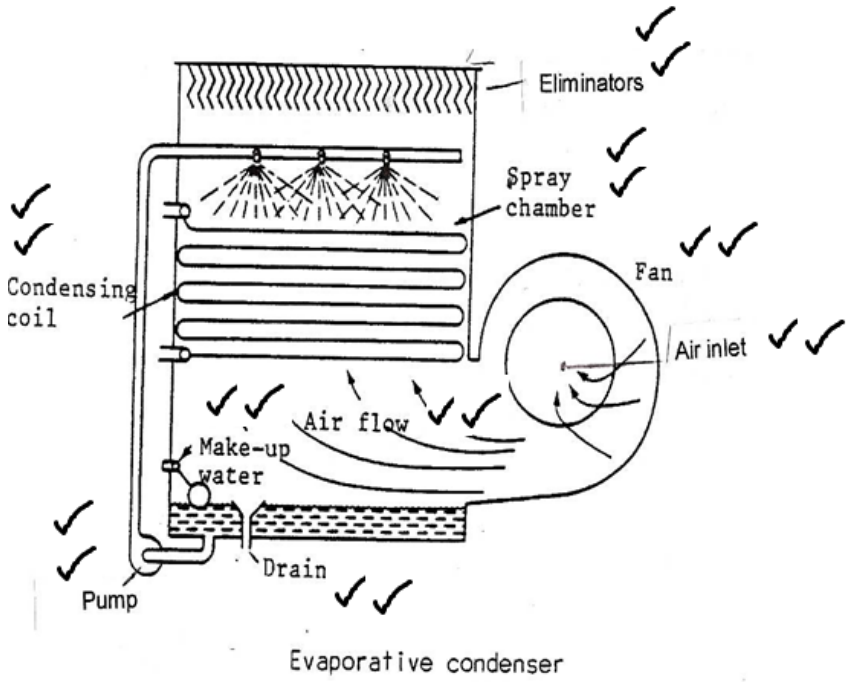
2.2




(Any relevant 6 × 2) (12)
**[19]**

## QUESTION 3

3.1 3.1.1

$$\text{Mass flow} = \frac{\text{Load}}{\text{Re}}$$

$$= \frac{50}{140} \checkmark$$

$$= 0{,}357 \text{ kg/s} \checkmark \rightarrow$$ (2)

3.1.2

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

$$= \frac{140}{5} \checkmark$$

$$= 28 \text{ kJ/kg} \checkmark$$ (2)

3.1.3

$$\text{Power} = \frac{\text{WD} \times \dot{M}}{\eta}$$

$$= \frac{28 \times 0{,}357}{0{,}85} \checkmark$$

$$= 11{,}76 \text{ kW} \checkmark$$ (2)

3.1.4 $THR = Re + WD$
$= 140 + 28$ ✓
$= 168\ kJ/kg$ ✓ (2)

3.2.1 A defrost thermostat is responsible for stopping frost forming on evaporators, in order to avoid the increased costs of less efficient refrigeration. ✓ It does this by activating either an electrical heating element or a hot gas valve to increase the temperature across the evaporator and melt the frost. ✓
(Any relevant 2 × 1) (2)

3.2.2
- Time✓ – the defrost thermostat activates at specific time intervals, regardless of the level of frost✓
- Temperature ✓– the defrost thermostat measure the temperature of the evaporator, activating once it reaches a set point to warm and defrost the evaporator✓
- Frost thickness ✓– an infrared sensor is used to measure how much frost built up and activate the heating element once it reaches a certain thickness. ✓ (Any relevant 3 × 2) (6)

3.3
- Black steel
- Galvanised steel
- Stainless steel (3)

3.4 It cannot cope with sudden load changes. (Any relevant 1 × 2) (2)
**[21]**

**QUESTION 4**

4.1
- Using a solenoid valve
- Superheat adjustment
- Regulation of evaporator pressure (3)

4.2
- Lubricate moving parts by a thin film of oil to minimize friction and prevent wear
- Create a Fluid seal
- Act a coolant in compressor
- Dampen noise in compressor crankcase (Any relevant 4 × 1) (4)

4.3 A heat exchanger is a device that transfers heat from the liquid refrigerant to the suction gas. ✓ Any device which brings two substances of different temperatures into contact 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 assure that the suction gas flowing into the compressor is dry. 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 6 × 1) (6)

4.4

| POSSIBLE CAUSES | CORRECTIVE MEASURES |
|---|---|
| • Faulty wiring | • Repair wiring. |
| • Low voltage | • Determine reason and correct. |
| • Faulty starting capacitor | • Check and replace capacitor. |
| • Starting relay open | • Determine and correct. |
| • Discharge pressure to high | • Allow pressure to equalise. |
| • Mechanical defect in compressor | • Replace compressor. |

(Any relevant 3 × 2) (6)

4.5 The prime function of an oil separator is to separate oil from the refrigerant and return it to the compressor crankcase. (Any relevant 1 × 1) (1)

**[20]**

**QUESTION 5**

5.1 5.1.1 Reciprocating pump (1)

5.1.2 A: Discharge/Delivery valve
B: Intake/Suction valve
C: Piston and piston rod
D: Cylinder
E: Connecting rod (5)

5.2 A: Head-available curve
B: Efficiency curve
C: Head-required curve
D: Operation point (4)

5.3 5.3.1
- Refrigerant
- Refrigeration capacity
- Design suction pressure
- Maximum crankcase pressure recommended by the compressor manufacturer
- Pressure drop across the valve at design load conditions

(5 × 1) (5)

5.3.2 A = Inlet

B = Screw

C = Spring

D = Seat disc

E = Outlet (5)

**[20]**

**TOTAL: 100**

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