higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

REFRIGERATION AND AIR CONDITIONING PROCESSES
NQF LEVEL 4

22 November 2024

This marking guideline consists of 6 pages.

Copyright reserved

QUESTION 1

1.1
1.1.1 D✓
1.1.2 E✓
1.1.3 B✓
1.1.4 C✓
1.1.5 A✓

(5 × 1) (5)

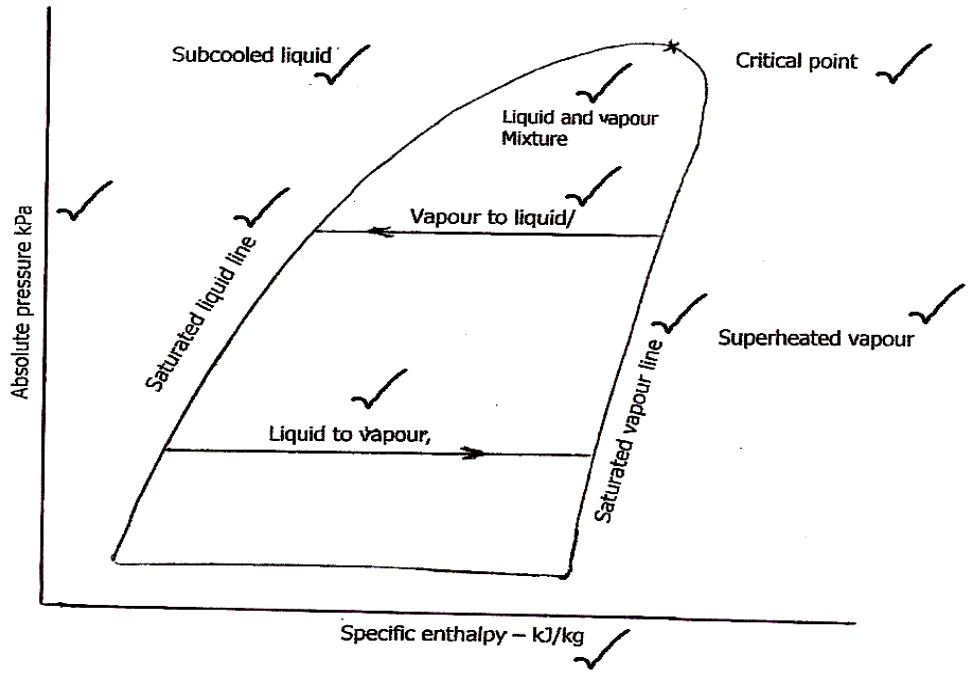
1.2
- Adaptable refrigerant flow✓
- Keeps evaporator active and in optimal performance✓
- High power efficiency✓
- Eliminates risks of compressor breakdown✓
- Handles variation in refrigerant charge✓
- Better temperature control✓ (Any 3 × 1) (3)

1.3 It tends to act as an insulator and decrease the efficiency of the system.✓ (1)

1.4
- Eyes become dry and irritated✓
- Low humidity can generate static electricity, damaging electronics and causing discomfort. ✓
- Dry air can harbour more airborne pathogens and allergens, reducing indoor air quality✓
- Low humidity can make the air feel colder than it actually is, leading to increased energy consumption as the AC works harder to maintain the desired temperature✓
- Dry air can irritate the eyes, nose, and throat, causing discomfort and health issues✓
- Hair becomes unmanageable✓
- Wooden furniture contracts which caused loose joints✓ (Any ONE)

(1)

1.5



(10)

QUESTION 2

2.1 2.1.1 $m_1 = \frac{V}{v} = \frac{44✓}{0.826✓} = 53.269kg/min✓$

$m_2 = \frac{V}{v} = \frac{18✓}{0.889✓} = 20.247kg/min✓$ (6)

2.1.2 $m_1 + m_2 = 53.269 + 20.247$

$= 73.516kg/min✓$ (1)

2.1.3 $$\frac{m_1}{m_2} = \frac{\boldsymbol{\omega}_2 - \boldsymbol{\omega}_3}{\boldsymbol{\omega}_3 - \boldsymbol{\omega}_1}$$

$$\frac{53.269✓}{20.247} = \frac{0.0182 - \boldsymbol{\omega}_3✓}{\boldsymbol{\omega}_3 - 0.01}$$

$\boldsymbol{\omega}_3$ $=0.012258$kg of H_2O per kg of dry air✓ (3)

2.1.4 $$\frac{m_1}{m_2} = \frac{h_2 - h_3}{h_3 - h_1}$$

$$\frac{53.269}{20.247} = \frac{79 - h_3}{h_3 - 39.4}$$

$$2.631 = \frac{79 - h_3✓}{h_3 - 39.4}$$

$h_3 = 50{,}306\ kJ$ per kg of dry air✓ (2)

2.2 2.2.1 Mass = load/Re
= 35/135✓
= 0,259 kg/s✓ (2)

2.2.2 COP = Re/WD x m **OR** WD = $\frac{35}{4.9 \times 0{,}259}$
WD = Re/COP✓ = 27,579 kJ/kg
= 135/4,9
= 27,551 kJ/kg✓
Slight difference in answers due to rounding off (2)

2.2.3 P = WD × m/ŋ
= 27,551 × 0,259/0,8✓
= 8,92 kW✓ accept 8,929 kW. (2)

2.2.4 THR = Re+ WD
= 135 + 27,551✓
= 162,551 kJ/kg✓ accept 162,579 kJ/kg (2)

[20]

Copyright reserved

QUESTION 3

3.1 3.1.1 Manometers are mainly used for measuring airflow in ducts and also for checking drafts.✓

3.1.2 An anemometer is used to measure airflow at outlet grills.✓

3.1.3 A pitot tube is used to determine air velocity.✓

3.1.4 A barometer is used to determine the pressure of the atmosphere at any place or time.✓

3.1.5 A velocity meter can indicate the velocity without the arithmetic required when using a pitot tube.✓

(5 × 1) (5)

3.2
- Recover all the gas in the system✓
- Disconnect all the pipes and electrical connections from the systems ✓
- Connect the H.P (high-pressure) gauge onto the discharge pipe and take readings✓
- Switch on the compressor after electrical reconnections and recharging✓
- Pressure on the gauge must climb rapidly to 3 000 kPa to be OK✓

(5)

3.3 To front seat a service valve means to turn the service valve stem of the valve clockwise until it seals the front valve seat.✓ (1)

3.4 To crack a service valve means that one front seats the valve and then turns it back a quarter of a turn; the same procedure on the back seat.✓ (1)

3.5 A filter drier consists of a cylinder filled with a chemical which absorbs the moisture✓ from the refrigerant flowing through it and traps impurities.✓ It is fitted in the liquid line between the condenser and the expansion valve.✓ (3)

3.6
- Pressure type✓
- Thermostatic type✓ (2)

3.7
- Range adjustment✓
- Differential adjustment✓ (2)

3.8
- Halide leak detector✓
- Soap and water solution✓
- Electronic leak detector✓
- Visual inspection✓

(Any ONE) (1)

[20]

Copyright reserved

QUESTION 4

4.1 The overload protects the compressor motor against overload✓ and high head pressure.✓ (2)

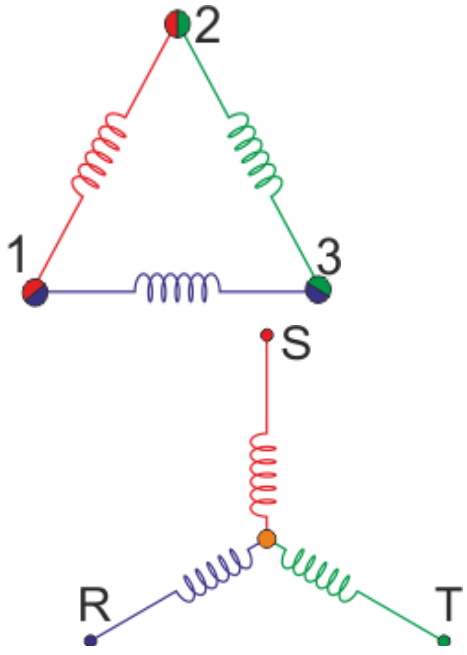
4.2 Neutral line✓ (1)

4.3
- Oil pressure safety switch✓
- Low pressure switch✓
- High pressure switch✓
- Time delay relay✓
- Motor temperature and overload switch✓ (5)

4.4
- Draws less amperage compared to a single phase motor.✓
- The low amperage drawn per phase means that thinner cables can be used.✓
- They are smaller in size compared to single-phase motors of the same capacity.✓
- Three-phase systems are balanced, which means that the current between all the phases is the same.✓
- Smoother Operation: Less vibration and noise, precise control

(Any 4 × 1) (4)

4.5



(2 × 3) (6)

4.6
- It will not perform✓
- May result in damage✓
- Electric shock or fire as a safety hazard✓
- My result in vibrations and noise✓
- May cause reverse rotation and damage the system✓

(Any 2 × 1) (2)
[20]

QUESTION 5

5.1 5.1.1

- Frequent stopping and starting of the plant✓
- High humidity due to excessive plant stoppage✓
- Excessive maximum demand charge✓
- Suction pressure temperature too low✓
- Condensing temperature too low✓ (Any 4 × 1) (4)

5.1.2

- Longer running time✓
- Insufficient defrost time✓
- Design temperature not reached✓
- Suction temperature higher than design✓
- Condensing temperature higher than design✓ (Any 4 × 1) (4)

5.2

- Run the system✓with discharge valve closed for seconds and close suction valve and recover remaining refrigerant✓
- Shut off power: Disconnect and lock out power✓
- Disconnect electrical and refrigerant lines connections✓
- Remove mounting hardware and document the process✓ (4)

5.3 5.3.1

- Low voltage to unit✓
- Starting relay open✓
- Starting winding open✓
- Faulty or worn-out bearings: Motor bearings can wear out or become damaged, causing the motor to hum instead of rotate.
- Overheating or burnt windings: Motor windings can overheat or burn due to electrical issues, causing the motor to hum.
- Capacitor failure: A faulty or failed capacitor can prevent the motor from receiving the necessary power to rotate, causing it to hum. (Any 4 × 1)

(4)

5.3.2

- Determine reason and correct✓
- Replace relay✓
- Replace compressor✓
- Replacing faulty bearings: Replacing worn-out or damaged bearings with new ones. ✓
- Rewinding or replacing the motor: Rewinding or replacing the motor if the windings are burnt or damaged. ✓
- Tightening or replacing connections: Tightening or replacing loose or corroded electrical connections. ✓ (Any 4 × 1)

(4)
[20]

TOTAL: 100

Copyright reserved