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UA STAR

**Commercial Refrigeration Service Technician
Exam**

STUDY GUIDE

(With Practice Exams)



**United Association Training Department
&**



FERRIS STATE UNIVERSITY

**The University Center for Extended Learning
Corporate & Professional Development Services**

FORWARD

This Study Guide is designed to assist you in locating information in UA Textbooks and other sources that relate to the 9 categories and 32 tasks identified during the DACUM (Develop A CUrriculUM) process administered by Ferris State University. The DACUM is an in-depth job and task analysis that serves as the base for the UA STAR exam.

The 9 categories and 32 tasks identified during the DACUM are included in this Study Guide so that you can see first-hand the results of the study and the items that you can expect to encounter on the UA STAR exam. Each category and task is numbered, and each task is broken into a number of smaller jobs that a technician would be expected to perform in order to complete the task.

Below each task you will find an underlined paragraph that looks like this and contains general reference to UA textbooks and other sources. In some cases, specific pages are cited. In others, chapters, but in most, only general reference is given.

You will find that the UA STAR exam is a comprehensive exam. It is designed to test the knowledge of the experienced technician. As such, this Study Guide is intended to be a reference for the experienced technician to use in preparing for the exam. It is expected that the inexperienced technician will not be able to successfully complete the exam based on the Study Guide and the information contained in the reference materials alone – experience is also required.

It is expected that the UA STAR test candidate is the technician who has completed the UA training and has gained several years of experience in the field. Many of the tasks and jobs identified in the DACUM are those that can only be learned by doing. The test candidate that expects to achieve success on the UA STAR exam by merely using the Study Guide to locate information in textbooks will likely be disappointed.

It is recognized that even the best technician does not work in all areas of the service industry. Further, some knowledge can be forgotten through lack of use. As such, it is recommended that you study a number of UA textbooks and other resources indicated in preparing for the UA STAR exam. A list is provided on the next page. These texts were cited throughout the Study Guide. You may wish to review the texts where you feel you need additional knowledge. In addition, there are many other excellent books on the market that can serve as reference for you. They are far too numerous to list. You may know of some of them or even own them. Feel free to use them in your studies.

The UA and Delmar text books contain many, many good questions that provide excellent practice material and act as a learning tool. If you spend time and answer the questions at the back of the texts successfully, you will be successful on the UA STAR exam.

This Study Guide also contains nearly 200 practice questions. All questions are multiple choice, with four possible answers. All questions contain explanations for each of the correct answers. The questions are designed to help you review

some of the material that you will need to know when taking the exam. The practice test will indicate to you whether or not you have areas of difficulty.

With the areas of difficulty identified, you can look into references identified and update your knowledge before taking the certification test.

The UA STAR exam is a tough test, but fair and recognized by your industry. With some hard work, you can be successful in passing it. Good luck!

UA Textbooks used as Reference in this Study Guide

UAHTM = United Association HVACR Training Manual

UAEPAM = United Association Environmental Protection Agency Training Manual

UARSM = United Association Refrigeration Mechanical Equipment Service Manual

UARCM = United Association Refrigeration Control Manual

UABEM = United Association Basic Electricity Manual

UAECSM = United Association Electrical Controls for Mechanical Equipment Service Manual

UAECSMTSG = United Association Electrical Controls for Mechanical Equipment Service Manual-Troubleshooting Guide

UACSS = United Association Customer Service Skills

www.thermistor.com

<http://www.henrytech.com/Tips/HT-TT6.pdf>

<http://www.packless.com/subcool/subcool.html>

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Category A: Refrigeration Fundamentals

Task 1. Refrigeration principles

Analyze system conditions, using a Pressure/Temperature (P/T) chart
Identify refrigeration system components
Explain the operation of a "simple" refrigeration system
Calibrate a Thermometer
Read temperatures in a refrigeration system
Define refrigeration cycle terminology
Identify common abbreviations
Explain heat transfer, in terms of sensible and latent heat, that occurs in the refrigeration cycle
Define "refrigeration"
Identify the four major components of the vapor compression refrigeration cycle
Explain the effects of: superheating the suction gas, increasing the condensing pressure, subcooling the liquid
Explain the importance of subcooling and superheat
Separate the components of the high side from the low side of the refrigeration system
Explain how fluids flow
Identify the state, pressure, temperature, and condition of the refrigerant at key points in the refrigeration cycle
Given a saturation temperature, determine the refrigerant pressure
Given a pressure of a saturated refrigerant, determine its temperature
Explain "temperature glide"
Explain the function of major components of the refrigeration system
Plot a P-H diagram for an operating refrigeration system
Locate superheat specification on datasheet
Explain how 25,400 microns compares to one inch of vacuum
Explain system pressures and temperatures in terms of "saturation point", "sub-cooled liquid", and "superheated vapor"
Describe the relationship of air flow to pressures, temperatures and coil performance
Describe the effect of non-condensable in the refrigeration system
Identify requirements of product preservation
Humidity requirements
Air quality (ambient)

Reference

United Association HVACR Training Manual, Sections 1, 3, 21 and 25

Task 2. Refrigerants and Oils

Explain problems occurring from using the wrong oil type
Explain the pressure-temperature relationship of refrigerants
Explain why systems using blended refrigerants must be charged as a liquid:
Identify type of refrigerant using pressure/temperature chart
List common refrigerant types
Match common refrigerant types with related color codes
Match refrigerant types with the correct compressor oil type
Recognize that refrigerant oil is heavier than refrigerant liquid
Recognize that refrigerant oils are hygroscopic and take steps to avoid oil contamination
Refrigerant types:
--hydrocarbon refrigerants
--hydrochloroflourocarbon refrigerants
--chlorofluorocarbon refrigerants
--hydro fluorocarbon refrigerants
Blended refrigerants
Refrigerant oils
--alkyl benzene oils
--glycols
--esters
Safety classifications and nomenclature

Reference

United Association HVACR Training Manual, Sections 3 and 9

Task 3. Refrigerant Safety

Demonstrate an understanding of safety policies and practices by passing the safety examination
Demonstrate appropriate fire prevention and response
Demonstrate use of safety tools, equipment and procedures
Weight of a refrigerant drum (tare weight)
Disposable vs. reusable tanks
Determine the safe capacity of refrigerant in a cylinder
Identify conditions which cause refrigerants to become toxic

Reference

United Association HVACR Training Manual, Sections 4, 7 and 8

Task 4. Refrigerant Handling and Transportation Regulations

Ozone, ozone depletion, and global warming
List at least five safety procedures to be followed when handling
refrigerant cylinders.

410A

Refrigerant recovery (passive and active recovery)

Refrigerant recycling

Refrigerant reclaiming

Procedures

--recovering refrigerant from a system with an operative compressor

--recovering refrigerant from a system with a self-contained recovery unit

Reference

United Association HVACR Training Manual, Sections 3 and 9

United Association Environmental Protection Agency Training Manual,

Page 38

Category B: Refrigeration System Operation

Task 5. Piping

Fabricate and install hangers, struts, and supports

Braze (solder) copper pipe

--Solder copper to copper pipe

--Solder copper to steel

--Solder copper to brass

Install pipe with proper pitch

Insulate, glue, and cradle pipe

Repair leaks on racks or single unit piping

Explain purpose of suction line traps

Explain when reduced risers are required

Identify pipe fittings by sight

Identify pipe size by sight (ID and OD)

Identify size of insulation used on medium- or low-temperature lines

Explain proper procedures for underground piping

Identify types of copper tubing

Select the appropriate type of copper tubing for a given application

Identify types of brass fittings

Select the appropriate type of brass fitting for a given application

Identify types of hand and shut-off valves

Select the appropriate hand valve or shut-off valve for a given application

Demonstrate proper methods of component heat protection when brazing

Demonstrate knowledge of proper nitrogen purge while brazing

Explain the effect of nitrogen purging during brazing

Explain proper pressure testing procedures and required micron level
specifications

Use charts and tables to calculate pressure loss from fittings and pipe runs
Explain proper use of vibration eliminators
Demonstrate knowledge of proper installation of vibration eliminators
Demonstrate knowledge of proper sealing of threaded pipe connections
Demonstrate knowledge of proper pipe flaring procedures
Demonstrate knowledge of proper pipe swedging procedures
Read refrigeration system legend
Read store maps and diagrams
Describe piping layout schemes

Reference

United Association HVACR Training Manual, Sections 7 and 25
United Association Refrigeration Mechanical Equipment Service Manual,
Pages
245-254

Task 6. Compressor

Explain key factors relating to proper oil return to the compressor
Explain the affect of reversed rotation on various compressor types
Identify compressor components
Identify compressor types
Compare compressor suction pressure, discharge pressure, and power consumption to manufacturer's performance curves
Demonstrate a fundamental understanding of a compound compressor
Explain how to determine cause of compressor failure
Determine size, BTUs and application
Explain the purpose of capacity control systems
Explain the relationship between discharge air temperature and liquid line differential settings
Explain the three factors that control compressor capacity (suction pressure, compression ratio, and x)
Explain the typical cause of grounded compressor windings
Explain why it may be permissible to install a resistor across a single open thermistor in a compressor
Identify devices used to protect against reverse rotation on some screw compressors
List possible causes for broken compressor connecting rods
Explain impact of high compression ratio
Explain liquid injection system operation (demand cooling)
Explain oil level control valve operation
Explain oil pressure safety switch operation
Define the term "de-superheat" as it applies to compound compressors
Identify typical applications of a satellite compressor
Calculate compressor compression ratio
Identify some factors that affect compressor capacity

Reference

United Association HVACR Training Manual, Sections 3, 14, 23, 29, 36, 38 and 48

Task 7. Condensers

Explain how to check for proper fan motor rotation and how to correct it, if necessary

Explain how to determine the presence of non-condensable

Identify condenser components

Determine heat transfer of condenser

Select appropriate condenser for application

Identify condenser types:

--air cooled

--water cooled

--evaporative

Recognize failing condenser fan motors

Explain proper fan cycling and sequencing

Identify and explain the function of an air cooled condenser

Describe the effect of non-condensable in the refrigeration system

Replace motor on condenser

Clean condenser

Determine conditions that impact condenser capacity

Explain split condenser operation

Identify different methods of head pressure control and temperature

Reference

United Association HVACR Training Manual, Sections 3, 22 and 33

United Association Refrigeration Control Manual, Pages 107-115

Task 8. Expansion Devices

Identify TXV types:

--balance port

--conventional

--electronic

--pressure limiting

--automatic

Adjust superheat setting on TXV

Explain the operation of various expansion valves

Identify difference between internal and external equalizing

Different types of TX valves for different refrigerants

Different types of temperature (C, Z, limiting, cross-charges)

Identify different types of capillary tubes

Identify different types of low and high side floats

Distributors and T's

Reference

United Association Refrigeration Control Manual, Pages 1-13, 15-21, 31-35, and 43-51
United Association HVACR Training Manual, Section 24

Task 9. Evaporators

How air flow effects transfer heat variable
Determine latent and sensible heat
Different refrigerant configurations
Air flow (counter flow and draw-through) that effects air flow patterns
Use of heat exchangers
Condensate
Placement (low velocity vs. high velocity)
Pressure drop
Pitch of the blade
Fan blade application
Explain pressure drop across a coil

Reference

United Association Refrigeration Control Manual, Pages 37-51, 428-430
United Association HVACR Training Manual, Sections 3 and 21

Task 10. Start-up and Commission Systems

Refrigerant Leak Test (Check) with electronic leak detector
Refrigerant Leak Test (Check) with soap bubble solution
Refrigerant Leak Test (Check) with nitrogen and trace gas (R-22)
Pressure Test a System with dry nitrogen
Evacuate a system using three point evacuation
Charge system with refrigerant
Liquid charge system
Vapor charge system
Repair Leaks
Adjust EPR/SORIT valves
Examine environmental conditions of the store
Check refrigerant level and moisture
Check oil level on all compressors
Set condenser fan and pressure controls
Adjust pressure regulating controls
Adjust differential Pressure Regulating controls
Check superheat and adjust expansion valve as required

Set defrost schedule for cases and units
Program and Commission micro-controller
Optimize energy management features
Record initial system operating parameters (System Vital Signs)
Check electrical
Explain operation to owner

Reference

United Association HVACR Training Manual, Sections 4, 8, 10, 25, 28 and 38

Category C: Basic Electricity

Task 11. Electrical Theory

Direct current
Alternating current
Ohms law
Conductors
Insulators
Electrical quantities

Reference

United Association HVACR Training Manual, Sections 2 and 12
United Association Basic Electricity Manual, Pages 26-27, 33-35 and 83-87

Task 12. Measuring Instruments

Voltmeters
Ammeters
Ohmmeters
Analog meters
Digital meters
Multimeters
Megometer
Micro amp meter

Reference

United Association HVACR Training Manual, Unit 5
United Association Basic Electricity Manual, Pages 43-55 and 67-128

Task 13. Electrical Circuits (Series and Parallel)

Wiring diagrams
Wire size
Circuit protection (fuses, circuit breakers, GFCI)

Reference

United Association HVACR Training Manual, Sections 12, 15 and 17
United Association Basic Electricity Manual, Pages 43-60, 99-102 and
123-128
United Association Electrical Controls for Mechanical Equipment Service
Manual, Page 7

Task 14. Electric Service

120/240 V. single-phase service
Three-phase service

Reference

United Association HVACR Training Manual, Sections 12, 17, 18, 19, and
39,
Unit 5
United Association Basic Electricity Manual, Pages 83-87, 99-102 and
123-128 United Association Refrigeration Mechanical Equipment
Service Manual, V1,
Pages 276-277, 291-292 and 311-321
United Association Refrigeration Mechanical Equipment Service Manual,
V2,
Pages 511-516

Category D: Controls

Task 15. Electric Motors and Starting Components

Motor uses
Motor power and starting torque
Motor types
Single-phase motors
Three-phase motors
Variable speed motors
Procedures
--identifying the common, start, and run terminals on a split-phase motor

--checking the coil and contacts
--check capacitors
Motor starters and contactors

Identify start circuit components
Phase monitors

Reference

United Association HVACR Training Manual, Sections 17, 18, 19, 25 and
39
United Association Electrical Controls for Mechanical Equipment Service
Manual – Troubleshooting Guide, Page 29
United Association Refrigeration Mechanical Equipment Service Manual,
V1,
Pages 276-277

Task 16. Automatic Controls and Devices

Overloads
Overload on three-phase motors
Limit switches
Fan switches
Fan-limit switches
Thermostats (line voltage and low voltage types and programmable)
Magnetically operated devices (solenoids, control transformers and
variable-speed motor controls)
Electromagnetic devices (relays, contactors, motor starters, defrost timers,
flow switches, and float switches)
Pressure switches and controls (high, low, dual, and oil safety)
Electronic controls (solid-state relays, starting relays, timers, thermistors,
transducers)

Reference

United Association HVACR Training Manual, Sections 14, 22, 24 and 25
United Association Refrigeration Control Manual, Pages 1-13, 43-51 and
88-92
www.thermistor.com

Task 17. Electrical Troubleshooting

Control-circuit problems:
--holding coils
--thermostats
--transformers
--control fuses
--pressure controls and safety devices

--lock out circuits
Power-circuit problems:
--contactors and relay contacts
--circuit breakers and fuses
--fan motors and compressor motors
--capacitors
--utility supply problems (under and over voltage problems)
Service call 1: Blown line voltage fuse
Service call 2: defective transformer

Service call 3: defective contactor
Service call 4: burned motor windings
Service call 5: grounded compressor

Reference

United Association HVACR Training Manual, Section 25
United Association Refrigeration Mechanical Equipment Service Manual,
Page 373

Category E: Rack Systems

Task 18. Demonstrate General Knowledge of Rack Systems

Multiple compressors with parallel racks (common piping)
Capacity control
Efficiency in electrical use
Pressure control
Transducers
Load distribution and balance load
Multiplex systems

Reference

United Association HVACR Training Manual, Sections 19, 25 and 26

Task 19. Install and Maintain Oil Control Systems

Importance of oil return
Install oil separator
Cooling oil with refrigerant

Adjust oil regulators to generate proper oil level
Adjust oil differential regulator to set pressure
Install differential pressure check valve
Recognize that refrigerant oils are "hygroscopic" and take steps to prevent contamination

Reference

www.henrytech.com/Tips/HT-TT6.pdf
United Association HVACR Training Manual, Sections 25 and 26
United Association Refrigeration Mechanical Equipment Service Manual,
Page 393

Task 20. Add Liquid Subcooling

Types--mechanical and ambient
Used to cool the oil and reduce temperature of liquid refrigerant

Reference

www.packless.com/subcool/subcool.html
United Association HVACR Training Manual, Sections 3 and 48

Task 21. Perform Basic Service on "Rack" System

Install and remove refrigeration manifold gauges
Recover refrigerant from a system
Perform evacuation and dehydration techniques
Liquid and vapor charge a refrigeration system
Determine system charge
Determine and adjust superheat
Determine subcooling
Use a sling/ electronic psychomotor to check environmental conditions
Explain the need to replace vacuum pump oil on a routine basis and after evacuation of a wet or contaminated system
Identify when system evacuation is required
Recognize a "wet" system
Explain "Critical Charged System"
Locate and use technical references
Weigh in refrigerant
Adjust head pressure
Check pressure drop across components
Check electrical components
Determine capabilities of the rack

Reference

United Association HVACR Training Manual, Sections 3 and 29

Category F: Self-Contained Units

Task 22. Metering Devices

- Critical charge for the capillary tube
- Critical charge for the automatic expansion valve
- Sizing of the thermostatic expansion valve

Reference

United Association HVACR Training Manual, Sections 3, 24, 25 and 45

Task 23. Charging Procedures

- Vapor charging
- Liquid charging
- Checking refrigerant charge
- Check superheat at compressor and subcooling
- Weigh in the charge for critically charged systems
- Control applications
- Determine temperature control per application

Reference

United Association HVACR Training Manual, Sections 3, 9, 10, 24, 25 and 45

Task 24. Perform Maintenance on Self-contained Unit

- Check for abnormal noise or vibrations
- Check condenser air flow for restrictions
- Check refrigerant level
- Check for refrigerant, oil and water leaks (Visual)
- Check condensate pan / pump operation
- Clean condenser coil (wash or blow out)
- Clean condensate pan
- Check and record system vital signs

Reference

Category G: Ice Machines

Task 25. Clean and Sanitize the Machine

- Remove ice from bin
- Use special cleaner to remove mineral deposits from evaporator and water-related components
- Change filters
- Flush system thoroughly
- Verify or adjust proper water level
- Purpose of cleaning and sanitizing - eliminate bacteria

Reference

United Association HVACR Training Manual, Section 27

Task 26. Service Ice Machine

- Start-up and check ice production
- Remove first two batches of ice
- Record initial system operating parameters (System Vital Signs):
 - ambient temperature
 - current draw
 - operating conditions
- Check operating pressures
- Check water flow
- Take water temperature
- Calculate batch or cycle time for production or clock production
- Clean condenser on air- and water-cooled systems
- Comply with manufacturer's recommendations
- Adjust float assembly, if necessary
- Check inlet water filter and check water quality
- Check water regulating valve on water-cooled systems
- Winterize ice machines:
 - Drain and blow out all lines
 - Disconnect power

Reference

United Association HVACR Training Manual, Section 27
www.thermistor.com

Category H: Auxiliary Systems

Task 27. Hot Water Heat Reclaim Systems

Operation and piping is critical
Operation of heat-reclaim and solenoid valves
Water flow
Recovery
Pressure regulated valve operation and problems with loss of head pressure
Importance of proper charge with change in ambient temperature, except for properly designed systems
Most popular--subcooling liquid
Function:
--Improves system efficiency
--Can be used to reduce flash gas for entering metering device
Identify two types of subcooling use--ambient and mechanical
Check for proper operation; replace unit, if required

Reference

United Association HVACR Training Manual, Sections 22 and 26

Task 28. Defrost Systems

Explain the need for defrosting
Differentiate between defrost types and methods (hot gas, cool gas, electric, off-time, reverse air)
Explain store operations and effects on operation and settings of refrigeration system
Explain the role of defrost in case operation
List common defrost termination system types
Explain the terms "drip cycle", and "drain cycle"

Reference

United Association HVACR Training Manual, Sections 2 and 25
United Association Refrigeration Mechanical Equipment Service Manual, Pages 430-435
United Association Refrigeration Mechanical Equipment Service Manual, Pages 428-430 and 432-435

Category I: Business and Customer Relations

Task 29. Establish Customer Relations

- Acknowledge customer needs
- Resolve complaints
- Explain value of services to customer
- Clean work site
- Demonstrate customer telephone etiquette
- Explain service performed in layman's terms
- Perceive customer's preferred level of detail in explanations
- Communicate effectively with an angry customer.
- Deal with technician delays and scheduling realities
- Explain contract terms
- Acknowledge customer needs
- Avoid escalation of emotion
- Communicates effectively
- Document product condition upon arrival
- Follow-up with customer
- Prioritize jobs
- Resolve complaints
- Sell yourself and the company to the customer
- Clarify customer complaints
- Explain unit operation to the customer
- Describe unit problem to the customer
- Estimate repair costs

Reference

United Association Customer Service Skills, Pages 13, 40 47 and 49

Task 31. Keep Records, Document Work Performed

- Track/maintain inventory
- Document refrigerant handling/usage
- Submit required paperwork
- Complete startup/commissioning form
- Prepare customer invoice/statement
- Maintain vehicle records
- Maintain MSDS sheets
- Complete service report
- Complete warranty paperwork requirements
- Complete operating log
- Complete PM checklist
- Complete required business operations reports
- Use computer to order and track replacement parts, if available

Warranty: Date parts to determine warranty coverage

Reference

United Association Customer Service Skills, Page 47

Task 32. Exhibit Professionalism

Participate in safety training
Participate in technical training
Obtain professional certifications
Participate in continuing education and training
Participate in OJT with co-workers
Participate in professional organizations (e.g., RSES, ACCA, RETA)
Study manufacturer's service manuals and company safety manuals
Read trade publications
Maintain personal and vehicle appearance
Keep tools and equipment in repair
Avoid work related safety/health risks
Demonstrate timeliness
Recommend system improvements to management.
Respect the property of others
Warranty: Follow warranty procedures regarding documentation, parts return
Demonstrate flexibility in accepting work assignments that stretch his/her
Demonstrate a willingness to learn

Reference

United Association Customer Service Skills, Pages 35 and 38
United Association HVACR Training Manual, Unit 4

(The Formula Study Guide is available a separate document with an individual work sheet for each formula – see UA-IOC for download).

Formulas

Energy Calculations

$$Q_{(\text{Total})} = 4.5 \times \text{CFM} \times \Delta h$$

$$Q_{(\text{Sensible})} = 1.10 \times \text{CFM} \times \Delta T$$

$$Q = \text{BTUH}$$

Δh = difference in enthalpy

Δg = difference in grains of moisture

ΔT = difference in temperature

Heat transfer

$$\text{BTUH} = \text{LB.} \times \Delta T \times \text{Specific heat (for any substance)}$$

$$\text{BTUH} = \text{CFM} \times \Delta T \times 1.08 \text{ (for standard air)}$$

$$\text{BTUH} = \text{GPM} \times \Delta T \times 500 \text{ (for water)}$$

Force exerted by a round diaphragm with a pressure applied and measured in psig

$$\text{Force} = \text{Area} \times \text{Pressure}$$

$$= \text{sq.in.} \times \frac{\text{pound}}{\text{sq.in.}}$$

$$= \pi r^2 \times \text{psig}$$

Pressure conversions

$$1 \text{ psi} = 2.31 \text{ feet of head}$$

$$1 \text{ psi} = 27.7 \text{ in. w.c.}$$

$$1 \text{ psi} = 2.04 \text{ in. Hg.}$$

$$1 \text{ atmosphere} = 34 \text{ feet of head}$$

$$1 \text{ atmosphere} = 29.9 \text{ in. Hg.}$$

$$1 \text{ atmosphere} = 14.7 \text{ psi}$$

w.c. = water column

in. Hg. = inches Mercury

Air pressure in ducts

$$V = 4005\sqrt{VP}$$

$$VP = \left(\frac{V}{4005} \right)^2$$

Airflow in duct:

$$Q = A \times V$$

$$Q = \text{CFM}$$

A = Cross sectional area of duct (ft²)

V=Velocity of air (feet per minute – FPM)

VP = inches water gage, "WG

Mixed air temperature (MAT)

$$\text{MAT} = \text{OAT} \times \% \text{OA} + \text{RAT} \times \% \text{RA}$$

Percent of outside air

$$\% \text{OA} = \frac{\text{RAT} - \text{MAT}}{\text{RAT} - \text{OAT}}$$

MAT=Mixed air temperature

OA=Outside air

OAT=Outside air temperature

RA=Return air

RAT=Return air temperature

Hydronic Pressure (Total Head)

Total Head = Static Head + Friction Head + Velocity Head

Static Head

Static Head = Static Discharge Head - Static

Suction Head

(calculated distance above pump as positive,

distance below pump as negative)

Velocity Head (VH)

$$VH = \frac{V^2}{2g}$$

g = 32.2 ft/sec² (acceleration due to gravity)

V = Velocity of liquid

Total Dynamic Head

$$\text{TDH} = (\text{DSH}-\text{SSH})+(\text{DVH}-\text{SVH})$$

TDH = Total dynamic head

DSH = Discharge static head

SSH = Suction static head

DVH = Discharge velocity head

SVH = Suction velocity head

Flow Coefficient (Cv) rating of valve

$$Cv = \frac{Q}{\sqrt{H}}$$

Q = flow rate in gpm
 H = head loss (pressure drop) in PSI
 Cv = flow coefficient with valve wide open, equal to gpm of flow at a 1 PSI pressure drop across the valve. Cv decreases as the valve closes.

Temperature conversions

$$^{\circ}F \text{ (Fahrenheit)} = ^{\circ}C \times \frac{9}{5} + 32$$

$$^{\circ}C \text{ (Celsius)} = (^{\circ}F - 32) \times \frac{5}{9}$$

$$^{\circ}R \text{ (Rankine)} = ^{\circ}F + 460$$

$$^{\circ}K \text{ (kelvin)} = ^{\circ}C + 273$$

Ohm's Law

$$\text{Volts} = \text{Amps} \times \text{Ohms}$$

or

$$E = I \times R$$

Watt's Law

$$\text{Watts} = \text{Volts} \times \text{Amps}$$

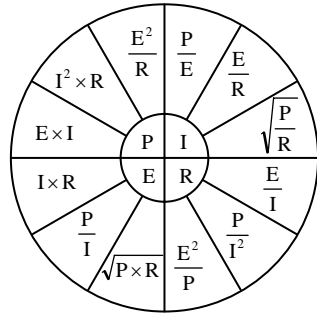
or

$$P = E \times I$$

Energy formula

$$W = P \times t$$

Formula Circle for Ohm's and Watt's Laws



E = voltage
 I = current (amps)
 P = power (watts)
 R = resistance (ohms)
 W = energy (kWh, or kilowatt-hour)
 t = time (hours)

Sum of resistance

Series circuits

$$R_T = R_1 + R_2 + R_3$$

Parallel circuits

$$R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

Sum of capacitance (C)

Series circuits

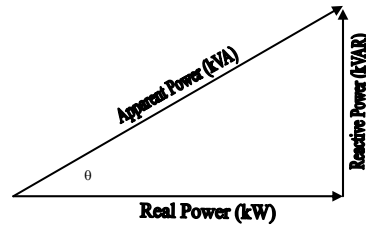
$$C_t = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

Parallel circuits

$$C_T = C_1 + C_2 + C_3$$

Power factor calculations

$$\text{Power Factor} = \frac{\text{true power (kW)}}{\text{apparent power (kVA)}} = \cos \theta$$



$$3\text{-phase apparent power (kVA)} = \frac{\text{Volts} \times \text{Amps} \times 1.73}{1000}$$

$$\text{single phase apparent power (kVA)} = \frac{\text{Volts} \times \text{Amps}}{1000}$$

$$\text{Re active power (kVAR)} = \sqrt{\text{kVA}^2 - \text{kW}^2}$$

Percent of motor load

$$\% \text{ load} = \frac{MA - 0.5NPA}{0.5NPA} \times \frac{MV}{MPV}$$

NA = Measured amps
 NPA = Nameplate amps
 MV = Measured volts
 MPV = Nameplate volts

Transformer voltage/winding calculation

$$E_s = E_p \times \frac{N_s}{N_p}$$

E_s = secondary voltage
 E_p = primary voltage
 N_s = number of secondary turns
 E_p = number of primary turns

Brake horsepower of a fan

$$\text{Bhp} = \text{NPhp} \times \frac{MA}{NPA} \times \frac{MV}{MPV} \times \text{LF}$$

NPhp = Nameplate horsepower
 MA = Measured amps
 NPA = Nameplate amps (FLA)
 MV = Measured volts
 NPV = Nameplate volts
 LF = Load factor (by table)

Brake horsepower of a pump

$$\text{Bhp} = \frac{\text{GPM} \times \text{TDH}}{3960 \times \text{Eff}} \times \text{specific gravity}$$

$$\text{Bhp} = \frac{\text{kW} \times \text{Eff}}{0.746}$$

$$\text{Pump efficiency} = \frac{\text{Total head} \times \text{GPM}}{3960 \times \text{Bhp}} \times \text{specific gravity}$$

GPM=Gallons per minute
 TDH = Total dynamic head
 Eff = Pump efficiency
 kW = real input power

Speed Calculation

Calculate new sheave diameter, changing motor sheave

$$\text{Dia}_{\text{new}} = \text{Dia}_{\text{old}} \times \frac{\text{RPM}_{\text{new}}}{\text{RPM}_{\text{old}}}$$

Compression ratio (R)

$$R = \frac{\text{Absolute discharge pressure}}{\text{Absolute suction pressure}}$$

Calculate new sheave diameter, changing fan or pump sheave

$$\text{Dia}_{\text{new}} = \text{Dia}_{\text{old}} \times \frac{\text{RPM}_{\text{old}}}{\text{RPM}_{\text{new}}} \text{ Fan Laws}$$

$$\text{CFM}_{\text{new}} = \text{CFM}_{\text{old}} \times \frac{\text{RPM}_{\text{new}}}{\text{RPM}_{\text{old}}}$$

$$\begin{aligned} \text{SP}_{\text{new}} &= \text{SP}_{\text{old}} \times \left(\frac{\text{CFM}_{\text{new}}}{\text{CFM}_{\text{old}}} \right)^2 \\ &= \text{SP}_{\text{old}} \times \left(\frac{\text{RPM}_{\text{new}}}{\text{RPM}_{\text{old}}} \right)^2 \end{aligned}$$

$$\begin{aligned} \text{BHP}_{\text{new}} &= \text{BHP}_{\text{old}} \times \left(\frac{\text{CFM}_{\text{new}}}{\text{CFM}_{\text{old}}} \right)^3 \\ &= \text{BHP}_{\text{old}} \times \left(\frac{\text{RPM}_{\text{new}}}{\text{RPM}_{\text{old}}} \right)^3 \end{aligned}$$

Pump Laws

$$\begin{aligned} \text{GPM}_{\text{new}} &= \text{GPM}_{\text{old}} \times \frac{D_{\text{new}}}{D_{\text{old}}} \\ &= \text{GPM}_{\text{old}} \times \frac{\text{RPM}_{\text{new}}}{\text{RPM}_{\text{old}}} \end{aligned}$$

$$\begin{aligned} \Delta P_{\text{new}} &= \Delta P_{\text{old}} \times \left(\frac{\text{GPM}_{\text{new}}}{\text{GPM}_{\text{old}}} \right)^2 \\ &= \Delta P_{\text{old}} \times \left(\frac{D_{\text{new}}}{D_{\text{old}}} \right)^2 \\ &= \Delta P_{\text{old}} \times \left(\frac{\text{RPM}_{\text{new}}}{\text{RPM}_{\text{old}}} \right)^2 \end{aligned}$$

$$\begin{aligned} \text{BHP}_{\text{new}} &= \text{BHP}_{\text{old}} \times \left(\frac{\text{GPM}_{\text{new}}}{\text{GPM}_{\text{old}}} \right)^3 \\ &= \text{BHP}_{\text{old}} \times \left(\frac{D_{\text{new}}}{D_{\text{old}}} \right)^3 \\ &= \text{BHP}_{\text{old}} \times \left(\frac{\text{RPM}_{\text{new}}}{\text{RPM}_{\text{old}}} \right)^3 \end{aligned}$$

General Gas Law

$$pV = mRT$$

Boyle's Law and Charles' Law

$T_1 p_2 = T_2 p_1$ (Charles' Law with constant volume)

$T_1 V_2 = T_2 V_1$ (Charles' Law with constant pressure)

$p_1 V_1 = p_2 V_2$ (Boyle's Law with constant temperature)

p =absolute pressure in pounds per square foot

V =volume in cubic feet

m =mass in pounds

R =gas constant of the particular gas (foot-pounds per pound per degree Rankine)

T =absolute temperature in degrees Rankine

Gas	R	Gas	R
Air	53.5	Hydrogen	765.9
Ammonia	90.5	Nitrogen	55.1
Carbon dioxide	35.1	Oxygen	48.3
Carbon monoxide	55.1	Sulfur dioxide	24.1

Practice Questions

Instructions:

The following questions are designed to give you the opportunity to practice for the UA STAR exam and to determine areas where you may need study and review.

Once you have taken the practice questions, you can check your answers using a separate document from the UA. This document contains explanations for most of the correct and incorrect answers. Task links are also provided with each question. These links direct you to specific areas of the DACUM. From there, you can locate the UA text to use for reference on your specific area of interest.

1. In a refrigeration system heat is rejected by
 - A. latent heat of condensation in the condenser
 - B. latent heat of vaporization in the evaporator
 - C. latent heat of vaporization in the condenser
 - D. latent heat of condensation in the evaporator

2. In a refrigeration system where does the refrigerant change from a low-pressure superheated vapor to a high-pressure superheated vapor?
 - A. compressor
 - B. condenser
 - C. metering device
 - D. evaporator

3. The main function of an expansion device is to?
 - A. subcool the refrigerant
 - B. superheat the refrigerant
 - C. meter the refrigerant
 - D. evaporate the refrigerant

4. The main function of a receiver is to
 - A. meter the refrigerant
 - B. reject heat from the system
 - C. store excess refrigerant
 - D. absorb heat from the system

5. How does a technician determine whether or not there is liquid refrigerant leaving the evaporator?
 - A. checks the amp draw of the compressor
 - B. feels the suction line to see if it is cold
 - C. calculates what the evaporator superheat is
 - D. takes a low side pressure reading on the system

6. Which of the following is NOT TRUE about refrigerant as it enters the condenser?
 - A. it is superheated
 - B. it is subcooled
 - C. it is in the form of a vapor
 - D. it comes directly from the compressor

7. Any additional heat added to the refrigerant after its 100% saturated vapor condition is called?
 - A. heat of Compression
 - B. latent heat
 - C. de-superheat
 - D. superheat

8. Most of the heat absorbed in the low side of a refrigeration system is.
 - A. heat of compression
 - B. sensible
 - C. latent heat
 - D. defrost heat

9. If a technician subtracted liquid line temperature from high side condensing temperature he would be calculating?
 - A. subcooling
 - B. heat of compression
 - C. superheat
 - D. refrigerant flow

10. An azeotropic refrigerant would be defined as.
 - A. a mixture of two or more refrigerants that have a large range of boiling points
 - B. a mixture of two or more refrigerants that have the same boiling point and act as one
 - C. a mixture of two or more refrigerants that have a range of boiling points for each system pressure.
 - D. a pure fluid

11. When a zeotropic refrigerant blend changes phase the refrigerants in the blend have different boiling points which can cause the refrigerant to
 - A. condense
 - B. vaporize
 - C. fractionate
 - D. dissipate

12. A refrigerant that is not miscible with mineral oil is
 - A. R-12
 - B. R-11
 - C. R-409A
 - D. R-404A

13. Which lubricant is most commonly used with HFC-134a refrigerant?
- A. polyolester
 - B. mineral
 - C. alkyl benzene
 - D. petroleum based oils
14. Polyol Ester oils are?
- A. resistant to the attraction of moisture
 - B. non hygroscopic
 - C. hygroscopic
 - D. sensitive to ambient temperatures
15. Refrigerant tanks must always be stored in an area where the temperature will not exceed
- A. 165° F
 - B. 115° F
 - C. 100° F
 - D. 125° F
16. When transferring refrigerants from a cylinder to a working system or any other container, the technician should always wear
- A. goggles with side shields and gloves
 - B. heavy protective clothing
 - C. rubber gloves
 - D. industrial steel-toed shoes and insulated cap
17. When entering a mechanical room where a refrigerant leak is suspected the technician should?
- A. open a window if possible for ventilation
 - B. hold his breath as long as possible
 - C. use the appropriate breathing apparatus until the area has been cleared of fumes
 - D. no extra care must be taken
18. Which of the following gasses is non flammable and would be preferred when leak testing a system?
- A. CO²
 - B. oxygen
 - C. nitrogen
 - D. both A or C
19. Refrigerant cylinders that are labeled "Disposable"
- A. by law cannot be refilled
 - B. are color-coded for easy identification
 - C. can be refilled/filled up to 80% of tank capacity
 - D. both A and B

20. A refrigerant cylinder that has been DOT approved for refilling must
- A. meet EPA standards
 - B. be recertified every 5 years
 - C. never be filled over 80% capacity
 - D. both B and C
21. When calculating how much refrigerant can be placed into a rechargeable cylinder, one must always take into account cylinder weight known as the
- A. tank lbs
 - B. cylinder lbs
 - C. tare lbs
 - D. 80% rule
22. All refrigerants have flammability and the toxicity classifications. Where could a technician best find those ratings?
- A. OSHA
 - B. the EPA
 - C. the BOCA code
 - D. the MSDS
23. Double suction riser are used in refrigeration system when
- A. large fluctuations in system capacity will occur
 - B. two or more compressors are installed on the system
 - C. there are multiple cases installed on one suction line
 - D. there is a cost savings with this practice
24. Suction risers are typically reduced by one size over that of the main suction run
- A. reduce installation costs
 - B. to avoid using a suction riser trap
 - C. to decrease velocity and reduce pressure drop
 - D. to increase refrigerant velocity to aid in proper oil return
25. When soldering a copper pipe connection which of the following processes allow for alloy to be drawn into the space between copper pipe and the fitting connection?
- A. conduction
 - B. drawing effect
 - C. capillary action
 - D. convection
26. Before proceeding to make any braze connection in a refrigeration system all of the internal piping should be purged of atmosphere with
- A. CO²
 - B. R-22
 - C. nitrogen
 - D. A or C

27. The liquid receiver is located between the?
- A. compressor suction and the evaporator
 - B. compressor discharge and the condenser
 - C. condenser and the expansion device
 - D. expansion device and the evaporator
28. Which device is used in a refrigeration system to protect the compressor from liquid slugs?
- A. suction accumulator
 - B. liquid receiver
 - C. TXV
 - D. none of the above
29. Which device is used to stop the flow of liquid or vapor in a refrigeration system?
- A. suction accumulator
 - B. liquid receiver
 - C. TXV
 - D. solenoid valve
30. Why is it important to know the direction that a scroll compressor is rotating?
- A. it will run smoother in one direction of rotation over the other
 - B. it will run quieter in one direction of rotation over the other
 - C. it will only pump refrigeration in one direction of rotation
 - D. rotation does not matter
31. An electric motor that has a voltage rating of 120 volts will have an upper and lower allowable voltage limit of
- A. 110 to 145 V
 - B. 100 to 200 V
 - C. 87.2 to 135 V
 - D. 108 to 132 V
32. On a fully welded hermetic compressor the electrical start components are located
- A. inside of the compressor shell
 - B. at the disconnect box for the compressor unit
 - C. at the thermostat
 - D. on the external of the compressor at the terminal box
33. On most hermetically sealed compressors
- A. the motor and pumping mechanism are cooled by liquid refrigerant
 - B. the motor does not come into contact with any refrigerant
 - C. the motor and pumping mechanism are cooled by refrigerant vapor
 - D. the belt drive must be adjusted precisely

34. The difference between oil pump discharge pressure and crankcase pressure on a refrigeration compressor would be called
- A. net oil pressure
 - B. gross oil pressure
 - C. differential oil pressure
 - D. net discharge pressure
35. The amount of space between the piston at top-dead-center and the bottom of the valve plate of the compressor would be defined as?
- A. clearance volume
 - B. displacement
 - C. total volume
 - D. dead space
36. The flapper valve design is less efficient than the discus valve design because
- A. the re-expanded refrigerant in the cylinder is much less
 - B. the spring tension is less
 - C. the cylinder has more clearance volume than the discus
 - D. it will allow liquid into the cylinder
37. Liquid refrigerant entering the compressor is potentially more damaging for this type of compressor over the others listed
- A. screw
 - B. reciprocating
 - C. scroll
 - D. rotary
38. Discus, ring, and flapper valves are not used on
- A. reciprocating compressors
 - B. screw compressors
 - C. scroll compressors
 - D. both b and c
39. The main function of a condenser in a refrigeration system is?
- A. reject the heat that is absorbed in the evaporator
 - B. change the refrigerant from a liquid to a vapor
 - C. absorb heat from the product or space
 - D. pump the refrigerant around the system
40. The shell and tube condenser is a type of
- A. low pressure condenser
 - B. air-cooled condenser
 - C. evaporative condenser
 - D. water cooled condenser

41. One of the main disadvantages of a water-cooled condenser is that mineral deposits
can build up acting as a/an
- A. restrictor
 - B. rust inhibitor
 - C. conductor
 - D. insulator
42. A flow regulating valve could be used on this type of condenser
- A. shell and tube
 - B. air cooled
 - C. tube in tube
 - D. Both A and C
43. On a water cooled condenser the water leaving the condenser is normally _____ lower than the condensing temperature of the unit
- A. 40° F
 - B. 35° F
 - C. 25° F
 - D. 10° F
44. On a standard efficiency air-cooled condenser the ambient air entering the condenser will be approximately _____ lower than the condensing temperature if the unit is under normal load and properly charged
- A. 10° F
 - B. 30° F
 - C. 55° F
 - D. 100° F
45. A head pressure control system would be used on this type of application
- A. unit located in a colder climate but only operating in summer months
 - B. unit located in a warm climate operating all year
 - C. unit located in a warm climate but only operating in the summer months
 - D. unit located in a colder climate operating all year
46. What type of expansion valve regulates its flow based from suction line superheat?
- A. hand expansion
 - B. TXV
 - C. automatic
 - D. none of the above

47. Systems where the pressure drop across the evaporator is excessive would typically use a/an.
- A. externally equalized TXV
 - B. internally equalized TXV
 - C. pressure limiting TXV
 - D. self equalizing TXV
48. On a system equipped with a TXV, when the load on an evaporator decreases.
- A. the TXV decreases the flow of refrigerant
 - B. the TXV increases the flow of refrigerant
 - C. the TXV will maintain the flow of refrigerant
 - D. the TXV decreases the pressure across the evaporator
49. When referring to a power head on an expansion device the bulb is
- A. on an automatic expansion valve
 - B. attached to one end of a capillary tube
 - C. at the inlet of the expansion valve
 - D. normally charged with a fluid similar to that of the system refrigerant
50. By subtracting the low side evaporator outlet temperature from the low side saturation temperature the technician would be calculating?
- A. compressor superheat
 - B. evaporator superheat
 - C. heat of compression
 - D. loss effect
51. On a typically evaporator employing a TXV the liquid refrigerant should be completely boiled to a vapor?
- A. near the evaporator outlet
 - B. approximately halfway through the evaporator
 - C. near the evaporator inlet
 - D. between the compressor and the evaporator
52. What type of TXV would be best for an application that was exposed to fluctuating ambient temperatures?
- A. balanced port TXVs
 - B. internally equalized TXV
 - C. pressure limiting TXV
 - D. self equalizing TXV

53. Pressure-limiting TXV's are generally applied on systems when
- A. the compressor will operate at low temperatures
 - B. it is necessary to shut off the condenser fan during a hot pull down
 - C. there are constant evaporator loads
 - D. it is necessary to shut off the refrigerant flow to the evaporator
- when the suction
pressure reaches a predetermined pressure
54. Which of the following is not true regarding the evaporator in a refrigeration system?
- A. it rejects heat from the conditioned space
 - B. it absorbs heat from the conditioned space
 - C. it removes moisture from the air stream
 - D. it allows for the latent heat of vaporization in a system
55. Heat that is added to the refrigerant stream after the 100% saturated vapor point is called?
- A. latent heat
 - B. artificial heat
 - C. extended heat
 - D. superheat
56. Multiple refrigerant circuits are preferred on evaporators that are?
- A. stainless steel tubed
 - B. copper tubed
 - C. small or short
 - D. large or long
57. In a system where the evaporator temperature operators above 32° F the technician needs to be concerned with?
- A. methods of defrosting the coil
 - B. adding refrigerant
 - C. increasing the rate of vaporization
 - D. none of the above
58. The fin spacing per inch on a medium-temperature evaporator is
- A. the same on a low-temperature evaporator
 - B. closer together than on low-temperature evaporator
 - C. farther apart than on low-temperature evaporators
 - D. the same on high-temperature evaporators
59. A refrigeration system that utilizes two or three stages of low temperature refrigeration
- A. uses flowing water to provide refrigeration
 - B. is called a cascade refrigeration system
 - C. provides medium temperature refrigeration
 - D. provides high temperature refrigeration

60. When leak testing a refrigeration system using a high pressure nitrogen tank the technician should always
- A. leak test through the low-side only
 - B. leak test through the high-side only
 - C. use a pressure regulator and safety relief valve at the nitrogen tank
 - D. never allow refrigerant to be mixed with the nitrogen
61. The maximum pressure that can be applied to a refrigeration system when pressure testing is
- A. 50 PSIG
 - B. 75 PSIG
 - C. determined by the systems rated nameplate test pressures
 - D. determined by the technician
62. The safest way to charge refrigerant into a system that is running is with
- A. vapor into the high side while under a vacuum
 - B. liquid into the high side while under a vacuum
 - C. vapor into the low side
 - D. liquid into the low side
63. When heating a refrigerant cylinder the technician should never use
- A. warm water
 - B. an electric heat blanket
 - C. any type of open flame
 - D. none of the above
64. Refrigeration systems must be fully evacuated before charging with refrigerant
- A. to de-pressurize the system for the expansion of refrigerant
 - B. to draw oil from the compressor during the dehydration process
 - C. to increase the rate of refrigerant flow through the expansion valve
 - D. to remove air and moisture from the system
65. A vacuum pump will lose its ability to draw a deep vacuum over time because
- A. the oil becomes full of moisture and acids which will decrease the capability of the vacuum pump
 - B. the refrigerant's pressure causes a break down of the vacuum pump oil
 - C. the vacuum in the pump causes the oil to become thinner which will cause excessive wear
 - D. the high speed of the vacuum pump will cause a breakdown of vacuum pump oil

66. A refrigerant service valve must be placed in the
- A. mid position in order for the technician to access the system
 - B. back seated position in order for the technician to access the system
 - C. front seated position in order for the technician to access the system
 - D. all of the above
67. When using a micron gauge to measure vacuum the system should be evacuated to a level of _____ to ensure that non condensables and moisture have been adequately removed
- A. 15000 microns
 - B. 10000 microns
 - C. 500 microns
 - D. 5000 microns
68. Amperage is a measure of
- A. electron flow
 - B. electrical pressure
 - C. electrical power
 - D. electrical resistance
69. Voltage is the measure of
- A. electron flow
 - B. electrical pressure
 - C. electrical power
 - D. electrical resistance
70. Wattage is a measure of
- A. electron flow
 - B. electrical pressure
 - C. electrical power
 - D. electrical resistance
71. 746 watts equals
- A. $\frac{1}{2}$ horsepower
 - B. 2 horsepower
 - C. 1 horsepower
 - D. none of the above
72. One kilowatt is equal to
- A. 3.412 Btus
 - B. 3412 Btus
 - C. 746 Btus
 - D. 3.142 Btus

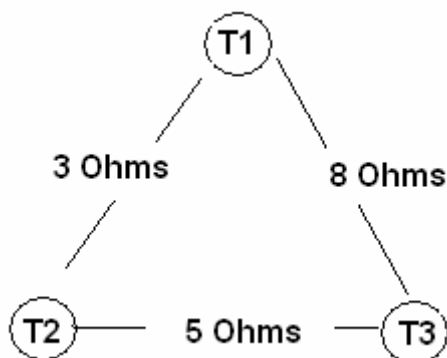
73. The unit of measurement for magnetic flux is?
- A. maxwell
 - B. gilbert
 - C. capacitance
 - D. eddy current
74. On a resistive electrical circuit which law would be used to calculate I, E or R?
- A. Boyles
 - B. Ohm's
 - C. Charles
 - D. none of the above
75. Which of the following formula would be used to calculate amperage in resistive circuit?
- A. $E=IR$
 - B. $R=EI$
 - C. $R=E/I$
 - D. $I=RE$
76. Capacitance represents a components ability to
- A. conduct flow electrons
 - B. resist flow of electrons
 - C. store electrons
 - D. create electrons
77. A meter with the capacity to measure very high resistances is call a?
- A. ammeter
 - B. digital voltmeter
 - C. analog voltmeter
 - D. megger
78. A technician would use a micron gauge to measure?
- A. suction pressure
 - B. deep vacuum
 - C. discharge pressure
 - D. electric current
79. If a technician has set his VOM meter to R x 100 he would be measuring
- A. resistance.
 - B. voltage
 - C. amperage
 - D. capacitance

80. When checking resistance through a motor winding the proper instruments to use would be a/an?
- A. megger
 - B. voltmeter
 - C. ammeter
 - D. ohmmeter
81. An ohmmeter will measure infinite resistance when testing an
- A. open fuse
 - B. open contacts
 - C. closed contacts
 - D. both A and B
82. If a technician has placed his VOM in parallel with an energized load he is probably checking?
- A. voltage
 - B. resistance
 - C. amperage
 - D. Ohm's
83. When a technician is checking unknown _____ he should always set the instrument to the highest scale to prevent damage to the meter.
- A. voltage
 - B. amperage
 - C. Ohm's
 - D. both A & B
84. If a technician has placed his VOM in series with the load he is probably checking?
- A. voltage
 - B. resistance
 - C. amperage
 - D. Ohm's
85. Which of the following instruments would be used to check the condition of insulation on a motors windings?
- A. ammeter
 - B. ohmmeter
 - C. voltmeter
 - D. megohmmeter
86. A ladder diagram can also be called
- A. a pictorial diagram
 - B. an oblique diagram
 - C. an orthographic projection
 - D. electrical line wiring diagram

87. A pictorial diagram will?
- A. use symbols that indicate function of equipment
 - B. emphasize "flow" of system
 - C. show approximate location of electrical system components
 - D. not show approximate location of electrical system components
88. The primary and secondary windings in a transformer are wired in?
- A. series
 - B. parallel
 - C. not connected electrically
 - D. series-parallel
89. What happens when the length of the path of an electrical circuit is decreased?
- A. there will be a no change in total circuit resistance.
 - B. there will be an increase in total circuit current
 - C. there will be an increase in total circuit resistance
 - D. there will be a decrease in total circuit resistance
90. What is the total amperage of a circuit when two 25 ohm resistors are connected in series using a 120 volt power source?
- A. 8 amps
 - B. 3.2 amps
 - C. 2.4 amps
 - D. 375 milliamps
91. If the voltage is the same across each load in a circuit it would be considered?
- A. parallel circuit
 - B. series circuit
 - C. series-parallel circuit
 - D. open circuit
92. If a circuit is designed to allow the flow of electrons to follow only one path it would be?
- A. a series-parallel circuit
 - B. a parallel circuit
 - C. a series circuit
 - D. rectifier circuit
93. A line or ladder type diagram is most useful for?
- A. showing the physical positions of the systems components
 - B. understanding circuit operation
 - C. doing the actual wiring
 - D. showing the color coding of wiring

94. If a technician took a reading across a normally closed set of contacts when a relay or contactor coil was de-energized the reading would be?
 A. 0 volts
 B. source voltage
 C. 0 ohms
 D. circuit amperage
95. An ohmmeter must never be connected to a,
 A. series-parallel circuit
 B. parallel circuit
 C. a de-energized circuit
 D. energized circuit
96. If a 24 volt control transformer has a VA rating of 60 what is the maximum amperage rating?
 A. .06 amp
 B. .6 amp
 C. 2.5 amp
 D. 9.6 amp
97. A technician has obtained the following resistance readings across the terminals on a single phase compressor: 8 ohms from T1 to T3, 3 ohms from T1 to T2, and 5 ohms from T2 to T3. Which terminals are RUN, START, and COMMON?
 Use the example below to answer this question
- A. T1 is Common
 T2 is Run
 T3 is Start
- B. T1 is Start
 T2 is Common
 T3 is Run
- C. T1 is Run
 T2 is Start
 T3 is Common
- D. T1 is Run
 T2 is Common
 T3 is Start

See diagram below:



98. The contacts of a current relay
- A. use back voltage (EMF) from the run winding to operate
 - B. use back voltage (EMF) from the start winding to operate
 - C. are normally open contacts
 - D. are normally closed contacts
99. A motor starter is also called a?
- A. motor controller
 - B. start relay
 - C. current relay
 - D. potential relay
100. If a relay coil is open the technician would read _____ when checking if with his ohmmeter
- A. infinite resistance
 - B. zero resistance
 - C. some resistance
 - D. both A or B
101. A sensor that uses a positive temperature coefficient thermistor (PTCT)
- A. decreases resistance as temperature increases
 - B. increases resistance as temperature increases
 - C. must be level for proper operation
 - D. must be installed near a supply air register for proper operations
102. These devices are used to protect electrical circuits from overcurrent
- A. relays and breakers
 - B. contactors and fuses
 - C. fuses and breakers
 - D. capacitors and relays
103. If two 30 μf run capacitors are wired in parallel what is the new microfarad rating on the circuit?
- A. 90 μf
 - B. 15 μf
 - C. 45 μf
 - D. 60 μf
104. On a hermetic compressor what component is designed into the compressor to protect against excessive temperatures and overcurrent
- A. a fuse
 - B. a breaker
 - C. an overload protector
 - D. a rectifier

105. The contacts of a potential relay
- A. are normally open
 - B. are normally closed
 - C. activate by amperage from the run winding
 - D. activate by amperage from the start winding
106. A rectifier is used to?
- A. reduce the voltage in a circuit
 - B. increase the resistance in a circuit
 - C. convert direct current to alternating current
 - D. convert alternating current to direct current
107. The run windings of a motor have _____ turns as compared to the start windings.
- A. fewer
 - B. more
 - C. the same number of
 - D. an infinite number of
108. On a typical split-phase electric motor the start winding circuit is de-energized by as it reaches approximately _____ of its operating speed?
- A. 50%
 - B. 65%
 - C. 75%
 - D. 90%
109. What component wired in series with the start windings on a single phase motor will create greater starting torque.
- A. a capacitor
 - B. a transistor
 - C. a rectifier
 - D. a thermistor
110. A three-phase motor does not have
- A. start windings
 - B. a start capacitor
 - C. a start relay
 - D. all of the above
111. A start component that is rated in microfarad would be a
- A. capacitor
 - B. thermistor
 - C. transistor
 - D. rectifier

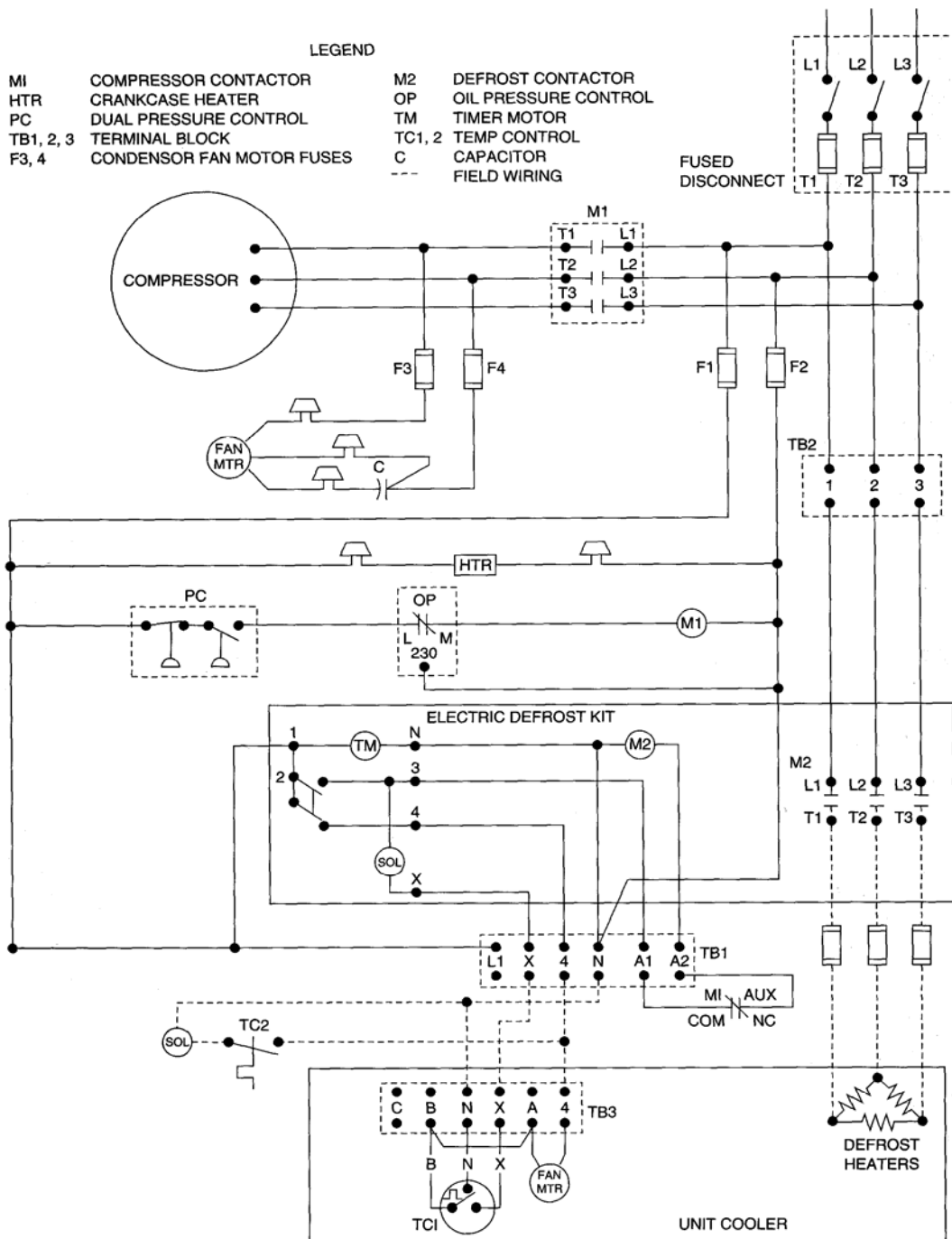
112. What effect will a higher supply voltage have on the current draw of an electric motor?
- A. it will be lower than it should be
 - B. it will remain the same
 - C. it will be higher than it should be
 - D. it will be erratic
113. With an electric motor running normally the amperage reading would be called?
- A. full-load amperage
 - B. run-load amperage
 - C. locked-rotor amperage
 - D. operating amperage
114. If a technician uses an ohm meter to check the windings of an electric motor and records an infinite reading on the start windings this would indicate?
- A. the start winding is shorting to ground
 - B. the start winding is shorting to the run winding
 - C. the start winding is shorting to itself
 - D. the start winding circuit has an open somewhere
115. What device would be discharged using a 20,000-ohm, 5 watt resistor?
- A. capacitor
 - B. thermistor
 - C. transistor
 - D. rectifier
116. The run-load amperage on an electric motor is typically
- A. $\frac{1}{2}$ that of the locked-rotor amperage
 - B. $\frac{1}{3}$ that of the locked-rotor amperage
 - C. $\frac{1}{5}$ that of a full-load amperage
 - D. $\frac{1}{10}$ that of full-load amperage
117. What device is used to energize another load such as a contactor or motor starter with in turn would start or stop a motor.
- A. a switch
 - B. a circuit breaker
 - C. a line fuse
 - D. a pilot duty relay
118. A magnetic coil and electrical contacts are the primary components of this electrical device?
- A. a centrifugal switch
 - B. a circuit breaker
 - C. a thermal overload
 - D. a contactor

119. A magnetic coil, overload protector and electrical contactors are the primary components of this electrical device
- A. a circuit breaker
 - B. a thermal overload
 - C. a contactor or relay
 - D. a motor starter
120. An electric motor that has an internal overload would have a?
- A. circuit breaker
 - B. a thermal device buried in the motor windings
 - C. line fuse
 - D. none of the above
121. What device could be used as external protection for a motor?
- A. a line fuse
 - B. a circuit breaker
 - C. an external overload
 - D. all of the above
122. What type of motor would a technician switch any two legs on to reverse the rotation of the motor?
- A. CSIR
 - B. CSCR
 - C. PSC
 - D. Three Phase
123. A technician could install this type of component on a refrigeration system that has multiplexed circuits to
- A. prevent the evaporator temperature on a multiplexed system from getting too high
 - B. prevent the evaporator temperature on a multiplexed system from falling too low
 - C. prevent the suction pressure on a multiplexed system from getting too high
 - D. prevent the suction pressure on a multiplexed system from getting too high
124. A technician would set this device by the RLA on the refrigeration compressors
- A. crankcase pressure regulator
 - B. evaporator pressure regulator
 - C. thermal expansion device
 - D. automatic expansion device

125. A technician would set this device by calculating the evaporator superheat.
- A. automatic expansion device
 - B. evaporator pressure regulator
 - C. low pressure control
 - D. thermal expansion device
126. What device is used to reduce the suction temperature of the compressor?
- A. desuperheating TXV
 - B. balance port TXV
 - C. pressure limiting TXV
 - D. pressure balancing TXV
127. If a technician needs to control the head pressure on a refrigeration unit within tight limits the best device to employ on the condenser fan motor would be?
- A. a variable frequency drive (VFD)
 - B. a modulator
 - C. a headmaster control
 - D. fan cycling
128. The EPR valve is installed between the?
- A. suction accumulator and the compressor
 - B. liquid line and the evaporator
 - C. evaporator and the suction accumulator
 - D. A or C
129. Which of these devices would be considered a low ambient temperature head pressure control used on an outdoor unit?
- A. CPR
 - B. fan cycling
 - C. EPR
 - D. off-cycle defrost
130. If a technician wanted to protect a refrigeration system from operating under excessive head pressure situations he would install a/an
- A. evaporator pressure regulator
 - B. head pressure control
 - C. crankcase pressure regulator
 - D. low pressure control

131. The following device would use a pressure transducer to sense net oil pressure, electronic oil safety controllers use a
- A. pressure gauge
 - B. thermal expansion device
 - C. mechanical oil safety control
 - D. electronic oil safety control
132. If a technician needed high accuracy it would be best to select a device that employed the following sensing element if available
- A. a helical bimetal
 - B. a refrigerant filled sensing element
 - C. a snap disc bimetal
 - D. a thermistor
133. If a technician installed a low-pressure switch, a liquid line solenoid valve, and a thermostat in a refrigeration system what kind of circuit would have been designed?
- A. a hot gas bypass circuit
 - B. a hot gas defrost circuit
 - C. automatic pump down cycle
 - D. manual pump down cycle

Use this diagram to answer the next five questions (134-138)



134. The compressor on a walk-in freezer has just restarted after a defrost cycle but the technician notices that the evaporator fans are not operating. What would the first component that the technician would focus on in this situation?
- A. the evaporator fan since it has obviously failed
 - B. the defrost timer since the contacts powering terminal 4 have obviously failed

- C. check for voltage at the unit cooler at terminals A and 4
 - D. the defrost termination switch
135. If the liquid line pump-down solenoid is leaking slightly what would the most obvious symptom be?
- A. the compressor would not shut-down
 - B. the compressor would not start
 - C. the compressor would short cycle
 - D. there would not be a symptom
136. What terminal on the defrost timer is used to terminate the defrost cycle early if all of the ice has been melted from the evaporator coil?
- A. terminal 3
 - B. terminal 4
 - C. terminal X
 - D. terminal N
137. What do terminals L1 and N provide for at the defrost timer?
- A. power for the defrost motor
 - B. power for the liquid line pumpdown solenoid
 - C. power for the evaporator fans
 - D. all of the above
138. At what terminal is the electrical interlock between M1 and M2 wired in this diagram?
- A. A1 and A2
 - B. B and X
 - C. 4 and N
 - D. there is not an electrical interlock device in this schematic
139. Large or small compressors on parallel compressor racks, which are usually dedicated to the coldest cases, are called?
- A. satellite compressors
 - B. remote compressors
 - C. booster compressors
 - D. both A and C
140. What is a true statement regarding the operation of a parallel rack system?
- A. it allows for better temperature control than a single condensing unit
 - B. it allows for multiple evaporator temperatures to be maintained
 - C. it allows for greater operational safety versus a single condensing unit
 - D. all of the above

141. Why is it important for the oil separator to be sized properly, insulated and located as close to the compressor as possible?
- A. to minimize the chances of refrigerant vapor to condense into liquid between the condenser and the receiver
 - B. to minimize the chances of refrigerant vapor to condense into liquid between the evaporator and the compressor
 - C. to minimize the chances for liquid refrigerant to vaporize inside the separator
 - D. to minimize the chances for refrigerant vapor to condense into liquid inside the separator
142. The capacity that a parallel rack will have during operation is determined by?
- A. the coldest temperature evaporator
 - B. the medium temperature evaporator
 - C. the warmest temperature evaporator
 - D. None of the above
143. On a parallel compressor rack what device is used to control multiple evaporators?
- A. CPR
 - B. LPC
 - C. EPR
 - D. HPC
144. What can cause the suction pressure on a parallel rack system to run higher than its setpoint?
- A. a lower than design system load
 - B. a higher than design system load
 - C. a lower than design outside ambient temperature
 - D. multiple dirty evaporators
145. Auxiliary contacts would not be used to?
- A. control a compressor
 - B. control a crankcase heater
 - C. control an interlock circuit
 - D. both B and C
146. What device would be used to cycle the condenser fans on and off as system head pressure changes?
- A. a reverse acting low- pressure control
 - B. a direct acting low-pressure control
 - C. a reverse acting high-pressure control
 - D. a direct acting high-pressure control

147. A device used to damper out compressor torque to the connected copper piping is a
- A. torque stopper
 - B. vibration enhancer
 - C. vibration deliminator
 - D. vibration eliminator
148. A device used to maintain a minimum oil condition in a parallel rack compressor is
- A. oil separator
 - B. oil reservoir
 - C. oil level control
 - D. oil filter
149. To maintain the correct amount of oil in each compressor on a parallel rack an oil system would require this/these components:
- A. oil separator
 - B. oil reservoir
 - C. oil level regulator
 - D. all of the above
150. What device is used on an oil system on a parallel to control the pressure of the oil feeding the oil regulator?
- A. a purge valve
 - B. a solenoid valve
 - C. pressure differential valve
 - D. an oil pressure valve
151. What is the best method for precharging an oil separator?
- A. put it through the discharge line
 - B. put it through the suction line
 - C. put it through return line from condenser
 - D. charge the oil directly into the separator before brazing into place
152. A decrease in suction pressure of a reciprocating compressor will result in:
- A. a decrease in the temperature of the discharge gas
 - B. an increased cooling of a hermetic compressor motor
 - C. a decrease in required compressor displacement
 - D. a decrease in volumetric efficiency
153. For every 1°F of additional liquid subcooling a systems capacity will be increased by approximately?
- A. ½%
 - B. 1%
 - C. 2%
 - D. 3%

154. These lines should be insulated to help maintain subcooling
- A. suction line
 - B. discharge line
 - C. liquid line
 - D. compressor
155. Additional liquid subcooling
- A. increases the amount of flash gas at the outlet of the TXV
 - B. maintains the amount of flash gas at the outlet of the TXV
 - C. reduces the amount of flash gas at the outlet of the TXV
 - D. has no effect on the amount of flash gas at the outlet of the TXV
156. What is the purpose of a mechanical subcooling loop on a parallel rack system?
- A. reduce the temperature of the liquid entering the metering device on the system performing the subcooling
 - B. reduce the temperature of the liquid entering the metering device on the system being subcooled
 - C. increase the capacity of system to which the liquid is being subcooled
 - D. both B and C
157. Inadequate liquid sub cooling in a system can cause?
- A. excessively high evaporator superheat
 - B. excessively low evaporator
 - C. excessively high discharge temperatures
 - D. both A and C
158. What device would be considered a non-modulating expansion device?
- A. a capillary tube
 - B. a pressure gage
 - C. a filter
 - D. a metering device
159. A CPR valve is used to protect the compressor from?
- A. low load pull-downs
 - B. high load pull-downs
 - C. amperage load over RLA
 - D. both B and C

160. What happens to the gauges if there is a high refrigerant charge in a system using a capillary tube?
- A. both the suction and discharge gauges will indicate a high pressure
 - B. both the suction and discharge gauges will indicate a low pressure
 - C. the suction gauges will indicate a higher-than-normal reading and the discharge gauges will indicate a lower-than-normal reading
 - D. the suction gauges will indicate a lower-than-normal reading and the discharge gauges will indicate a higher-than-normal reading
161. An overcharge with this type of device will cause a decrease in evaporator superheat?
- A. capillary tube
 - B. restrictor plate
 - C. TXV
 - D. both A and B
162. The Liquid receiver service valve could be used to?
- A. charge refrigerant into the system
 - B. remove refrigerant for the system
 - C. stop the flow of refrigerant for system pump down purposes
 - D. All of the above
163. A technician may need to bypass this control when charge a system
- A. compressor overload
 - B. thermostat
 - C. HPC
 - D. LPC
164. When charging liquid refrigerant into a compressor care must be taken because?
- A. refrigerant may fractionate
 - B. damage to the compressor may occur by liquid slugging
 - C. it is easier to overcharge the system
 - D. both B and C
165. Low suction pressure and under cooling can be caused by?
- A. excessive head pressure
 - B. high suction pressure and insufficient cooling
 - C. defective compressor
 - D. undercharged system
166. What type of refrigerants must be charged into a system in a liquid form?
- A. zeotropic refrigerants
 - B. near azetropic refrigerants
 - C. azetropic refrigerants
 - D. both A and B

167. A low pressure switch can be used to?
- A. initiate an off defrost cycle
 - B. control frost build-up on the coil
 - C. protect against high suction pressures on the low side
 - D. both A and B
168. What device is used to shut the compressor off if the suction falls below a given set point?
- A. HPC
 - B. LPC
 - C. EPR
 - D. CPR
169. What device is used to prevent refrigerant migration to the compressor during the off cycle?
- A. a crankcase heater
 - B. a suction accumulator
 - C. a pump-down cycle
 - D. A or C
170. On an ice machine the flush cycle is designed to?
- A. remove mineral build-up in the water
 - B. flush the holding bin
 - C. chemically treat the water
 - D. sanitize the ice cube trays
171. Carbon filtration is used to?
- A. sanitize the water
 - B. remove minerals from the water
 - C. remove chemicals from the water
 - D. de-ionize the water
172. The flaky coating that can build up on the surface of the evaporator on an ice machine is called?
- A. hardness
 - B. sediment
 - C. scale
 - D. turbidity
173. How is the ice harvest accomplished on most ice machine?
- A. by shutting the compressor off
 - B. by running hot water over the evaporator
 - C. by hot gas defrost
 - D. by electric defrost

174. What could cause an ice machines capacity in #'s per hour to be reduced?
- A. excessive mineral deposits on the evaporator plate
 - B. dirty condenser coil
 - C. higher than normal entering water temperature
 - D. any of the above
175. Sand and dirt in water are usually easily removed by?
- A. filters
 - B. reverse osmosis
 - C. distillation
 - D. de-ionization
176. As its temperature decreases, a/an _____ will decrease its resistance.
- A. PTC thermistor
 - B. NTC thermistor
 - C. cathode
 - D. anode
177. What type of valve is used to divert hot gas from the condenser to the reclaim coil??
- A. a desuperheating valve
 - B. a three way reversing valve
 - C. a two way heat reclaim valve
 - D. a three way heat reclaim valve
178. What is the media that is heated by a heat reclaim system?
- A. air
 - B. water
 - C. refrigerant
 - D. A and B
179. Why is a heat reclaim system so important?
- A. it allows heat to be recaptured from the refrigerant stream and reused.
 - B. it allows for reduced system refrigerant charges
 - C. it allows for reduced receiver sizes
 - D. all of the above
180. What is the function of a timer release solenoid?
- A. initiate the defrost cycle
 - B. maintain the defrost cycle
 - C. terminate the defrost cycle
 - D. none of the above

181. What component energizes the electric defrost heater on a 24-hour defrost timer?
- A. a normally open set of contactors
 - B. a normally closed set of contactors
 - C. the timer motor
 - D. the timer initiation solenoid
182. On an electric defrost system what device initiates the de-energizing of the heater if the evaporator temp rises above freezing before the timed defrost cycle ends?
- A. termination thermostat
 - B. timer release solenoid
 - C. defrost timer
 - D. case thermostat
183. What would the best method of defrost be for a fixture that has a case temperature below freezing and is operated by a single condensing unit located in a low ambient condition?
- A. hot gas defrost
 - B. electric defrost
 - C. forced defrost
 - D. off cycle air defrost
184. What is the BTU output of an electric defrost heater that is rated at 1200 watts?
- A. 5118 BTU's
 - B. 4096 BTU's
 - C. 4500 BTU's
 - D. 4000 BTU's
185. What would the best method of defrost be for a fixture that had an evaporator temperature below freezing but a case temperature above freezing?
- A. hot gas defrost
 - B. electric defrost
 - C. forced defrost
 - D. off cycle air defrost
186. On a supermarket rack employing hot gas defrost where would the hot gas solenoid valve be installed?
- A. between the liquid receiver and the liquid header
 - B. between the discharge line and the receiver
 - C. between the liquid return line and the receiver
 - D. between the discharge line and the oil separator

187. If you find yourself at odds with a confrontational customer, you should
- A. tell the customer you're not being paid to be a whipping post, pack your tools and leave.
 - B. tell the customer that you're not going to take his abuse, but try finishing the job.
 - C. defend yourself by telling the customer that it's not your fault and try to finish the job.
 - D. keep you cool, learn as much as possible about the customer's complaint, continue working if possible, but call your supervisor to report the incident
188. When entering a customer residential premises you should always
- A. wipe your feet on their rug to make sure you shoes are clean
 - B. remove your shoes at the door
 - C. place a clean pair of disposable covers over your shoes
 - D. let the customer know that you have checked your shoes and they are clean
189. If the technician is on a service call and notices another potential problem not related to the current work order, what should the technician do?
- A. don't bother to mention it and go ahead and repair it if you can do it quickly and it won't cost anything
 - B. generate a service ticket and replace the component
 - C. ignore it and hope that it turns into another service call for your company
 - D. discuss what you have found with the customer and your supervisor so that the customer can decide whether to authorize the additional repair.
190. Which of the following is a required part of the work order?
- A. wholesale cost of parts used
 - B. form completed in legible hand writing
 - C. complete list of materials used and amount of time spent on the job
 - D. both B and C
191. Getting the customer to sign the work order should be
- A. the first thing you should do before starting the work
 - B. the last thing that you should do before leaving the job
 - C. could be done at any time
 - D. either A or B

192. Which of the following is a part of your responsibility relative to your work crew?
- A. keeping to yourself and not bothering others
 - B. worrying about what others have been assigned to do by the supervisor
 - C. working safely on the worksite
 - D. keeping to yourself and not bothering others
193. You are called to a job site to perform some maintenance work on a system and after you are finished the customer approaches you and offers to pay you cash directly to perform some additional work. In this situation it would be ok to?
- A. accept the offer but tell him you will have to come back with your own truck and tools
 - B. negotiate with the customer to see if you can get him to increase his offer
 - C. accept the offer, but tell the customer that this is the only time that you will be able to help him out
 - D. refuse the offer politely and if it happens again notify your supervisor of the situation
194. What should the technician do in a situation where he is working on a refrigeration system that operates a case that holds perishable food items, the compressor has failed, it is 5:00 on a Monday evening, and it will take a few additional hours to repair the rack?
- A. leave the job site, go to dinner, and return after dinner to complete the job
 - B. request authorization from the customer to leave the job to go to dinner telling him that you will return that evening to finish the job
 - C. request authorization from the customer to stay on the job until it is finished that evening
 - D. request authorization from the customer to leave the job telling him that you will return first thing in the morning to finish the job

Practice Questions with Explanations

Instructions:

The following questions are designed to give you the opportunity to practice for the UA STAR exam and to determine areas where you may need study and review.

Once you have answered the practice questions, you can check your answers using a separate document from the UA. This document contains explanations for most of the correct and incorrect answers. Task links are also provided with each question. These links direct you to specific areas of the DACUM. From there, you can locate the UA text to use for reference on your specific area of interest.

A: Refrigeration Fundamentals

A-1 Refrigeration Principles

A-1-s

1. In a refrigeration system heat is rejected by
 - *A. latent heat of condensation in the condenser UAHTM 3.9**
 - B. latent heat of vaporization in the evaporator
 - C. latent heat of vaporization in the condenser
 - D. latent heat of condensation in the evaporator

The condenser is where the refrigerant is condensed (rejecting heat) and the evaporator is where the refrigerant is vaporized (absorbing heat).

A-1-s

2. In a refrigeration system where does the refrigerant change from a low-pressure superheated vapor to a high-pressure superheated vapor?
 - *A. compressor UAHTM 3.8**
 - B. condenser
 - C. metering device
 - D. evaporator

The compressor adds pressure and temperature to the refrigerant vapor

A-1-s

3. The main function of an expansion device is to?
 - A. subcool the refrigerant
 - B. superheat the refrigerant
 - *C. meter the refrigerant UAHTM 3.10**
 - D. evaporate the refrigerant

The expansion device meters the refrigerant into the evaporator and also creates the pressure differential between the high and low side of the system.

A-1-3

4. The main function of a receiver is to
 - A. meter the refrigerant
 - B. reject heat from the system
 - *C. store excess refrigerant UAHTM 25.32**
 - D. absorb heat from the system

A liquid receiver is used to store excess refrigerant after it leaves the condenser. It can also be used as a storage device to pump liquid into if the system requires repair.

A-1-o

5. How does a technician determine whether or not there is liquid refrigerant leaving the evaporator?
- A. checks the amp draw of the compressor
 - B. feels the suction line to see if it is cold
 - *C. calculates what the evaporator superheat is UAHTM 3.7**
 - D. takes a low side pressure reading on the system

The only way to calculate evaporator superheat is to take a evaporator pressure reading and convert that to a temperature. That temperature can then be subtracted from the evaporator outlet temperature to determine evaporator superheat.

A-1-o

6. Which of the following is NOT TRUE about refrigerant as it enters the condenser?
- A. it is superheated
 - *B. it is subcooled UAHTM 3.9**
 - C. it is in the form of a vapor
 - D. it comes directly from the compressor

The refrigerant vapor enters the condenser as a superheated vapor from the compressor.

The refrigerant is subcooled at the end of the condenser.

A-1-w

7. Any additional heat added to the refrigerant after its 100% saturated vapor condition is called?
- A. heat of compression
 - B. latent heat
 - C. de-superheat
 - *D. superheat UAHTM 1.7, 3.11**

Any additional heat added to the refrigerant after its 100% saturated vapor condition would be considered sensible heat and can be measured as an increase in temperature with a thermometer. Heating the vapor temperature above its boiling point is then considered superheat.

A-1-h

8. Most of the heat absorbed in the low side of a refrigeration system is.
- A. heat of compassion
 - B. sensible
 - *C. latent heat UHATM 1.7, 3.11, 21.10**
 - D. defrost heat

When a refrigerant changes state it absorbs or rejects latent heat. During this phase change the majority of the refrigerants potential to exchange heat energy is realized.

A-1-w

9. If a technician subtracted liquid line temperature from high side condensing temperature he would be calculating?

- *A. subcooling UAHTM 3.9**
- B. heat of compression
- C. superheat
- D. refrigerant flow

The only way to calculate condenser subcooling is to take a highside pressure reading and convert that to a temperature and subtract the condenser outlet temperature from the condensing temperature to determine condenser subcooling.

A-2 Refrigerants and Oils

A-2-e

10. An azeotropic refrigerant would be defined as.
- A. a mixture of two or more refrigerants that have a large range of boiling points

- *B. a mixture of two or more refrigerants that have the same boiling point and act as one UAHTM 3.12**

- C. a mixture of two or more refrigerants that have a range of boiling points for each system pressure.
- D. a pure fluid

Although these types of refrigerants are not pure fluid they act very similar and have negligible fractionation.

A-2-e

11. When a zeotropic refrigerant blend changes phase the refrigerants in the blend have different boiling points which can cause the refrigerant to

- A. condense
- B. vaporize
- *C. fractionate UAHTM 3-12, 9-10**
- D. dissipate

Zeotropic refrigerants are a mixture of two or more refrigerants that although mixed maintain their individual characteristics.

A-2-g

12. A refrigerant that is not miscible with mineral oil is

- A. R-12
- B. R-11
- C. R-409A
- *D. R-404A UAHTM 9-11 to 9-12**

R-404a is an HFC refrigerant and requires POE oil for proper system operation. mineral oils are not compatible with HFC refrigerants.

A-2-g

13. Which lubricant is most commonly used with HFC-134a refrigerant?

- *A. polyolester UAHTM 9.11-9.13**
- B. mineral
- C. alkyl benzene
- D. petroleum based oils

R-134a is an HFC refrigerant and requires POE oil for proper system operation. mineral oils are not compatible with HFC refrigerants.

A-2-i

14. Polyol Ester oils are?

- A. resistant to the attraction of moisture
- B. non hygroscopic
- *C. hygroscopic UAHTM 9.13**
- D. sensitive to ambient temperatures

All polyol ester oils have a very high attraction to water vapor and therefore the technician has to use extreme caution when working on a system that uses POE oils.

A-3 - Refrigerant Safety

A-3-a

15. Refrigerant tanks must always be stored in an area where the temperature will not exceed

- A. 165° F
- B. 115° F
- C. 100° F
- *D. 125° F UAHTM 4.2**

As the temperature of refrigerants increase the pressure also increases. With this in mind a technician should take care not to store refrigerants in areas where the temperature could exceed 125° F as to minimize the risk of having fusible plug or pressure relief valve from venting.

A-3-a

16. When transferring refrigerants from a cylinder to a working system or any other container, the technician should always wear

- *A. goggles with side shields and gloves UAHTM 4.2**
- B. heavy protective clothing
- C. rubber gloves
- D. industrial steel-toed shoes and insulated cap

Because a refrigerant release can produce extremely high velocities along with cold temperatures as the refrigerant evaporates a technician must wear protection at all times.

A-3-c

17. When entering a mechanical room where a refrigerant leak is suspected the technician should?
- A. open a window if possible for ventilation
 - B. hold his breath as long as possible
 - *C. use the appropriate breathing apparatus until the area has been cleared of fumes UAHTM 4.2**
 - D. no extra care must be taken
- Because refrigerant is heavier than air a technician must use extreme care when entering any confined space where refrigerant gases could accumulate.**

A-3-c

18. Which of the following gasses is non flammable and would be preferred when leak testing a system?
- A. CO²
 - B. oxygen
 - C. nitrogen
 - *D. both A or C UAHTM 4.1, 7.8, 8.19**
- Nitrogen and CO² are considered inert gases and are safe for leak testing refrigerant systems. Oxygen should never be used in this type of application since oxygen in the presents of oil can spontaneously combust.**

A-4 - Refrigerant Handling and Transportation Regulations

A-4-b

19. Refrigerant cylinders that are labeled "Disposable"
- A. by law cannot be refilled
 - B. are color-coded for easy identification
 - C. can be refilled/filled up to 80% of tank capacity
 - *D. both A and B UAHTM 3.18**
- As per DOT regulations disposable refrigerant cylinders cannot be refilled and are color coded per ASHRAE designations. There is a substantial fine for refilling a disposable cylinder!**

A-4-d

20. A refrigerant cylinder that has been DOT approved for refilling must
- A. meet EPA standards
 - B. be recertified every 5 years
 - *C. never be filled over 80% capacity UAHTM 9.17**
 - D. both B and C
- Refrigerant cylinders may not be filled to over 80% capacity so that there is room for liquid expansion if the cylinder warms. Also the regulation requires that the cylinder is re-checked every 5 years for safety reasons.**

A-4-d

21. When calculating how much refrigerant can be placed into a rechargeable cylinder, one must always take into account cylinder weight known as the
- A. tank lbs
 - B. cylinder lbs
 - *C. tare lbs** **UAEPAM Pg. 38**
 - D. 80% rule

All recovery tanks have a tare weight that is stamped on the tank. This is the weight of the empty tank. The technician must also know what type of refrigerant he will be placing in the tank.

A-4-m

22. All refrigerants have flammability and the toxicity classifications. Where could a technician best find those ratings?
- A. OSHA
 - B. the EPA
 - C. the BOCA code
 - *D. the MSDS** **UAHTM f 9-10**

Material Safety Data Sheets provide all types of pertinent information regarding a given material. This sheet would list the level of flammability and toxicity of a specific refrigerant.

B: Refrigeration System Operation

B-5 - Piping

B-5-f, g

23. Double suction riser are used in refrigeration system when
- *A. large fluctuations in system capacity will occur** **UARSM Pg. 245-248**

- B. two or more compressors are installed on the system
- C. there are multiple cases installed on one suction line
- D. there is a cost savings with this practice

If a system has a large variation in capacity in order to keep the suction riser velocity high a double line may have to be installed. During low refrigerant mass flow rates one of the suction riser traps will fill with oil and the other pipe will maintain enough velocity to maintain oil return to the compressor.

B-5-g

24. Suction risers are typically reduced by one size over that of the main suction run
- A. reduce installation costs
 - B. to avoid using a suction riser trap
 - C. to decrease velocity and reduce pressure drop
 - *D. to increase refrigerant velocity to aid in proper oil return**

UARSM Pg. 245-254

As a general rule suction risers line sizes are reduced by one size so that refrigerant velocities can be maintained at acceptable levels to insure proper oil return.

B-5-b

25. When soldering a copper pipe connection which of the following processes allow for alloy to be drawn into the space between copper pipe and the fitting connection?

- A. conduction
- B. drawing effect
- *C. capillary action** **UAHTM 7.9-7.11**
- D. convection

Capillary action is the process by which the alloy is drawn into the gap between the pipe and the fitting. In order for this to occur there must be enough clearance between the two connections.

B-5-t

26. Before proceeding to make any braze connection in a refrigeration system all of the internal piping should be purged of atmosphere with
- A. CO²
 - B. R-22
 - C. nitrogen
 - *D. A or C** **UAHTM 7.10**

By purging the atmosphere from the refrigerant piping the potential for copper oxides to be created during the brazing process is eliminated.

B-5-a, d

27. The liquid receiver is located between the?
- A. compressor suction and the evaporator
 - B. compressor discharge and the condenser
 - *C. condenser and the expansion device** **UAHTM 25.32**
 - D. expansion device and the evaporator

The liquid receiver is always located after the condenser and before the expansion device.

B-5-a, d

28. Which device is used in a refrigeration system to protect the compressor from liquid slugs?

- *A. suction accumulator UAHTM 25.59**
- B. liquid receiver
- C. TXV
- D. none of the above

The suction accumulator is located between the evaporator and the compressor and is used to protect the compressor from liquids entering the crankcase.

B-5-a, d

29. Which device is used to stop the flow of liquid or vapor in a refrigeration system?

- A. suction accumulator
- B. liquid receiver
- C. TXV
- *D. solenoid valve UAHTM 25.15**

The solenoid valve is the most frequently used component to control fluid flow in a refrigeration system. It can be designed as a NC or NO valve.

B-6 - Compressor

B-6-b

30. Why is it important to know the direction that a scroll compressor is rotating?

- A. it will run smoother in one direction of rotation over the other
- B. it will run quieter in one direction of rotation over the other
- *C. it will only pump refrigeration in one direction of rotation UAHTM 3.8, 36.16**
- D. rotation does not matter

Unlike a piston compressor, rotary technology is sensitive to rotation and therefore the motor can only operate on one direction in order for the mechanism to function properly scroll compressors.

B-6- f

31. An electric motor that has a voltage rating of 120 volts will have an upper and lower allowable voltage limit of

- A. 110 to 145 V
- B. 100 to 200 V
- C. .87.2 to 135 V
- *D 108 to 132 V UAHTM 38.7**

All electric motors are designed to operate within a range of + or – 10% of the design voltage.

B-6-d

32. On a fully welded hermetic compressor the electrical start components are located

- A. inside of the compressor shell
- B. at the disconnect box for the compressor unit
- C. at the thermostat
- *D. on the external of the compressor at the terminal box**

UAHTM 48.35

The electrical start components are located in the terminal box that is affixed to the shell of the compressor.

B-6-c

33. On most hermetically sealed compressors

- A. the motor and pumping mechanism are cooled by liquid refrigerant
- B. the motor does not come into contact with any refrigerant
- *C. the motor and pumping mechanism are cooled by refrigerant vapor**

UAHTM 29.11

D. the belt drive must be adjusted precisely

Refrigerant gas returning from the evaporator is used to cool the internal motor windings on most hermetically sealed compressors.

B-6-c

34. The difference between oil pump discharge pressure and crankcase pressure on

a refrigeration compressor would be called

- *A. net oil pressure UAHTM 14.13**
- B. gross oil pressure
- C. differential oil pressure
- D. net discharge pressure

On a refrigeration compressor the pump discharge will vary as the suction pressure fluctuates but the net oil pressure will always stay constant and will only decrease if the compressor crankcase gets low on oil, there is excess refrigerant in the oil, or the compressor bearing are becoming worn.

B-6-w, x

35. The amount of space between the piston at top-dead-center and the bottom

of the valve plate of the compressor would be defined as?

- *A. clearance volume UAHTM 23.6**
- B. displacement
- C. total volume
- D. dead space

Clearance volume is important because it affects the re-expansion volume in the cylinder. This in turn effects the capacity of the compressor at a given compression ratio.

B-6-d, x

36. The flapper valve design is less efficient than the discus valve design because

- A. the re-expanded refrigerant in the cylinder is much less
- B. the spring tension is less

***C. the cylinder has more clearance volume than the discus UAHTM 23.6-7**

- D. it will allow liquid into the cylinder

The discus valve on a Copeland compressor is more efficient because in the machining process the cylinder clearance was able to be reduced therefore reducing the re-expansion volume in the cylinder.

B-6-c

37. Liquid refrigerant entering the compressor is potentially more damaging for this type of compressor over the others listed

- A. screw

***B. reciprocating UAHTM 23.8**

- C. scroll

- D. rotary

Because of the design of a piston compressor if refrigerant is drawn into the cylinder when the piston reaches top dead center and liquid exists it will not be compressible and damage can occur.

B-6-d

38. Discus, ring, and flapper valves are not used on

- A. reciprocating compressors
- B. screw compressors
- C. scroll compressors

***D. both b and c UAHTM 23.7**

Discuss, ring and flapper valves are all associated with reciprocating technologies.

B-7- Condensers

B-7-i

39. The main function of a condenser in a refrigeration system is?

***A reject the heat that is absorbed in the evaporator UAHTM 3.9**

- B. Change the refrigerant from a liquid to a vapor

- C. absorb heat from the product or space

- D. pump the refrigerant around the system

The heat that is absorbed into the refrigerant in the evaporator is rejected in the condenser as the refrigerant changes phase from a vapor to a liquid.

B-7-f

40. The shell and tube condenser is a type of
- A. low pressure condenser
 - B. air-cooled condenser
 - C. evaporative condenser

***D. water cooled condenser UAHTM 22.2-22.3**

Shell and tube condensers and tube and tube condensers are water cooled in their design. with this type, water is circulated through the unit and carries the heat of the refrigerant away with it.

B-7-m

41. One of the main disadvantages of a water-cooled condenser is that mineral deposits can build up acting as a/an

- A. restrictor
- B. rust inhibitor
- C. conductor

***D. insulator UAHTM 22.4**

Water cooled condensers are sensitive to mineral deposit which can adhere to the internal surfaces of the condenser reducing its capacity to remove heat from the refrigerant.

B-7-c, f

42. A flow regulating valve could be used on this type of condenser
- A. shell and tube
 - B. air cooled
 - C. tube in tube

***D. both A and C UAHTM 33.4**

Shell and tube condensers and tube and tube condensers are water cooled in their design. with this type, water is circulated through the unit and carries the heat of the refrigerant away with it. A water flow regulating valve is used to modulate the amount of water that is passed through the condenser based from the high side pressure of the system. As evaporator loads decrease the high side pressure will also decrease and the water valve will close maintaining a constant head pressure and also conserving water.

B-7-f, m

43. On a water cooled condenser the water leaving the condenser is normally _____ lower than the condensing temperature of the unit

- A. 40° F
- B. 35° F
- C. 25° F

***D. 10° F UAHTM 22.9**

Water cooled condensers are normally designed around a 10° F TD between water entering and water leaving.

B-7-f, m

44. On a standard efficiency air-cooled condenser the ambient air entering the condenser will be approximately _____ lower than the condensing temperature if the unit is under normal load and properly charged
- A. 10° F
 - *B. 30° F UAHTM 22.15**
 - C. 55° F
 - D. 100° F

Air cooled condensers can be designed around any temperature difference however TD for a standard efficiency unit has been 30° F up until January of 2006. At that time higher federal energy standards went into place regarding residential A/C units.

B-7-o

45. A head pressure control system would be used on this type of application
- A. unit located in a colder climate but only operating in summer months
 - B. unit located in a warm climate operating all year
 - C. unit located in a warm climate but only operating in the summer months
 - *D. unit located in a colder climate operating all year UARCM Pg. 107-115**

On units that operate in varied ambient conditions it is necessary to use some type of device that will control the high side pressure on the system so that it does not drop to low during low.

B-8 - Expansion Devices

B-8-a

46. What type of expansion valve regulates its flow based from suction line superheat?
- A. hand expansion
 - *B. TXV UARCM Pg. 1-13**
 - C. automatic
 - D. none of the above

A thermal expansion valve has a liquid filled bulb that is connected to a powerhead via a capillary tube. The bulb is connected to the outlet of the evaporator and will modulate the flow of refrigerant based on the evaporator outlet temperature.

B-8-d

47. Systems where the pressure drop across the evaporator is excessive would typically use a/an.

- *A. externally equalized TXV UARCM Pg. 31-35**
- B. internally equalized TXV
- C. pressure limiting TXV
- D. self equalizing TXV

In systems that employ large evaporators it may be necessary to use an externally equalized expansion valve. This type of valve has a separate pressure tap that is connected to the outlet of the evaporator. This design aids in controlling evaporator superheat more precisely in such applications.

B-8-c

48. On a system equipped with a TXV, when the load on an evaporator decreases.

- *A. the TXV decreases the flow of refrigerant UARCM Pg. 1-13**
- B. the TXV increases the flow of refrigerant
- C. the TXV will maintain the flow of refrigerant
- D. the TXV decreases the pressure across the evaporator

As the load on an evaporator decreases the saturation point in the evaporator will move toward the outlet of the evaporator. This causes the temperature at the sensing bulb to decrease and the pressure within the power head to decrease thus throttling back the flow of refrigerant through the expansion device.

B-8-e

49. When referring to a power head on an expansion device the bulb is

- A. on an automatic expansion valve
- B. attached to one end of a capillary tube
- C. at the inlet of the expansion valve
- *D. normally charged with a fluid similar to that of the system refrigerant UARCM Pg. 15-21**

The power head circuit of an expansion valve is typically charged with a refrigerant that is similar to that of the refrigerant that is charged in the system.

B-8-b

50. By subtracting the low side evaporator outlet temperature from the low side

saturation temperature the technician would be calculating?

- A. compressor superheat
- *B. evaporator superheat UARCM Pg. 43-51**
- C. heat of compression
- D. loss effect

The only way to determine whether liquid refrigerant is not leaving the evaporator is to calculate evaporator superheat. Through this calculation the technician can determine if the saturation point on the low side is beyond that of the evaporator outlet.

B-8

51. On a typically evaporator employing a TXV the liquid refrigerant should be completely boiled to a vapor?

- *A. near the evaporator outlet UARCM Pg. 43.51**
- B. approximately halfway through the evaporator
- C. near the evaporator inlet
- D. between the compressor and the evaporator

To maintain the highest evaporator efficiency the saturation point in the evaporator should be maintained near the evaporator outlet but not beyond.

B-8-a, c

52. What type of TXV would be best for an application that was exposed to fluctuating ambient temperatures?

- *A. balanced port TXVs UAHTM 24.18**
- B. internally equalized TXV
- C. pressure limiting TXV
- D. self equalizing TXV

The balanced port expansion valve is the best choice in applications where fluctuating ambient temperatures occur or floating head pressure is employed.

B-8-a, c

53. Pressure-limiting TXV's are generally applied on systems when

- A the compressor will operate at low temperatures
- B. it is necessary to shut off the condenser fan during a hot pull down
- C there are constant evaporator loads
- *D it is necessary to shut off the refrigerant flow to the evaporator**

when the suction

pressure reaches a predetermined pressure. UARCM Pg. 43-51

Pressure-limiting TXV's limit the suction pressure so it does not cause the compressor to overheat during a hot pull down situations.

B-9 – Evaporators

B-9-b

54. Which of the following is not true regarding the evaporator in a refrigeration system?

- *A. it rejects heat from the conditioned space UAHTM 3.7**
- B. it absorbs heat from the conditioned space
- C. it removes moisture from the air stream
- D. it allows for the latent heat of vaporization in a system

Evaporators do not reject heat into the conditioned space, but rather absorb heat from the air that passes through the fin stock. The component that rejects heat in a refrigeration system is the condenser.

B-9-b

55. Heat that is added to the refrigerant stream after the 100% saturated vapor point is called?

- A. latent heat
- B. artificial heat
- C. extended heat
- *D. superheat UAHTM 21.9, UARCM Pg. 43-51**

Any heat that is added to the refrigerant after its 100% saturation vapor point would be sensible heat. This addition of sensible heat is measured in temperature and is referred to as superheat.

B-9-c, d

56. Multiple refrigerant circuits are preferred on evaporators that are?

- A. stainless steel tubed
- B. copper tubed
- C. small or short
- *D. large or long UARCM Pg. 37-42**

Evaporators that are large or long are designed with multiple refrigeration circuits to minimize the potential for pressure drop in the system.

B-9-c

57. In a system where the evaporator temperature operators above 32° F the technician needs to be concerned with?

- A. methods of defrosting the coil
- B. adding refrigerant
- C. increasing the rate of vaporization
- *D. none of the above UARSM Pg. 428-430**

In a system where the evaporator operation is above 32°F the technician would not have to be concerned with any of the items listed above. The system would not need a method of defrost since the coil would not collect frost

B-9-c

58. The fin spacing per inch on a medium-temperature evaporator is
- A. the same on a low-temperature evaporator
 - *B. closer together than on low-temperature evaporator**
UAHTM 21.17
 - C. farther apart than on low-temperature evaporators
 - D. the same on high-temperature evaporators
- Fin spacing on evaporators are based on the application. Medium temperature coils will have fins designed closer together since the potential for frost buildup is less.**

B-10 - Start-up and Commission Systems

B-10-d

59. A refrigeration system that utilizes two or three stages of low temperature refrigeration
- A. uses flowing water to provide refrigeration
 - *B. is called a cascade refrigeration system** **UAHTM 28.6**
 - C. provides medium temperature refrigeration
 - D. provides high temperature refrigeration
- Systems with operating temperatures down to about -160°F using the compression cycle may use a system called cascade refrigeration. Cascade refrigeration uses two or three stages of refrigeration depending on how low the lower temperature range may need to be.**

B-10-d

60. When leak testing a refrigeration system using a high pressure nitrogen tank the technician should always
- A. leak test through the low-side only
 - B. leak test through the high-side only
 - *C. use a pressure regulator and safety relief valve at the nitrogen tank** **UAHTM 4.1**
 - D. never allow refrigerant to be mixed with the nitrogen
- Nitrogen cylinders are shipped at 2500 psig and must have its pressure regulated before it can be used. The pressure in the tank is too great for a refrigeration system to withstand, causing the weak point of the system to burst. The pressure regulator is set to prevent this dangerous situation from occurring. A relief valve is also present to prevent tank pressure from reaching too high a level to cause tank, valve or regulator damage.**

B-10-d

61. The maximum pressure that can be applied to a refrigeration system when pressure testing is
- A. 50 PSIG
 - B. 75 PSIG
 - *C. determined by the systems rated nameplate test pressures UAHTM 4.1, 38.7**
 - D. determined by the technician
- A refrigeration system will have a design pressure rating for the high and the low side of the system, therefore when pressure testing a system the technician should not exceed the lower of the two ratings.**

B-10-h

62. The safest way to charge refrigerant into a system that is running is with
- A. vapor into the high side while under a vacuum
 - B. liquid into the high side while under a vacuum
 - *C. vapor into the low side UAHTM 10.2**
 - D. liquid into the low side
- Although slower, refrigerant should always be charged into the system in a vapor unless it is a blend and in that case it must be charged into the system in liquid form using some type of liquid expander to insure that the refrigerant is being fully vaporized.**

B-10-f

63. When heating a refrigerant cylinder the technician should never use
- A. warm water
 - B. an electric heat blanket
 - *C. any type of open flame UAHTM 4.1**
 - D. none of the above
- It is never expectable to use an open flame to heat a refrigerant cylinder.**

B-10-c

64. Refrigeration systems must be fully evacuated before charging with refrigerant
- A. to de-pressurize the system for the expansion of refrigerant
 - B. to draw oil from the compressor during the dehydration process
 - C. to increase the rate of refrigerant flow through the expansion valve
 - *D. to remove air and moisture from the system UAHTM 8.1-8.15**
- All non-condensables must be removed from a refrigeration system before charging the system with refrigerant. Failure to do so will result in poor system operation and shortened system life.**

B-10-c

65. A vacuum pump will lose its ability to draw a deep vacuum over time because
- *A. the oil becomes full of moisture and acids which will decrease the capability of the vacuum pump UAHTM 8.1-8.15**
 - B. the refrigerant's pressure causes a break down of the vacuum pump oil
 - C. the vacuum in the pump causes the oil to become thinner which will cause excessive wear
 - D. the high speed of the vacuum pump will cause a breakdown of vacuum pump oil

There is no way to completely eliminate contaminants from getting into the vacuum pump oil but changing oil regularly.

B-10-f

66. A refrigerant service valve must be placed in the
- *A. mid position in order for the technician to access the system UAHTM 25.41**
 - B. back seated position in order for the technician to access the system
 - C. front seated position in order for the technician to access the system
 - D. all of the above

In order for the service technician to gain access to a refrigeration system using a 3-way valve the valve must be placed in the mid seated position. Before the technician removes the gauge set the valve must be moved to its back seated position.

B-10-c

67. When using a micron gauge to measure vacuum the system should be evacuated to a level of _____ to ensure that non condensables and moisture have been adequately removed
- A. 5000 microns
 - B. 10000 microns
 - *C. 500 microns UAHTM 8.1-8.15**
 - D. 5000 microns

Pulling a vacuum to a level of 500 microns will insure that all non condensable have been removed from the system. This will insure that the system will not operate at a high head pressure or to be prone to acid formation.

C: Basic Electricity

C-11 - Electrical Theory

C-11-f

68. Amperage is a measure of

- *A. electron flow** UAHTM 12.8
- B. electrical pressure
- C. electrical power
- D. electrical resistance

Amperage is the amount of electron or current flow in an electrical circuit.

C-11-f

69. Voltage is the measure of

- A. electron flow
- *B. electrical pressure** UAHTM 12.8
- C. electrical power
- D. electrical resistance

Voltage is the potential electrical difference for electron flow from one line to another in an electrical circuit.

C-11-f

70. Wattage is a measure of

- A. electron flow
- B. electrical pressure
- *C. electrical power** UAHTM 12.14
- D. electrical resistance

Wattage is a unit of electrical power. 1 watt equals 3.41 btu's

C-11-f

71. 746 watts equals

- A. ½ horsepower
- B. 2 horsepower
- *C. 1 horsepower** UAHTM 2.13
- D. none of the above

When converting HP to watts the equivalent is roughly 746 watts equals one HP.

C-11-f

72. One kilowatt is equal to

- A. 3.412 Btus
- *B. 3412 Btus** UAHTM 2.14
- C. 746 Btus
- D. 3.142 Btus

1 watt equals 3.413 btu's and 1 kilowatt equals 1000 watts.

C-11-f

73. The unit of measurement for magnetic flux is?
*A. **maxwell** UABEM Pg. 26-27
B. gilbert
C. capacitance
D. eddy current

Magnetic flux is the equivalent of current in the electrical circuit and its unit of measurement is the Maxwell.

C-11-c

74. On a resistive electrical circuit which law would be used to calculate I, E or R?
A. Boyles
*B. **Ohm's** UABEM Pg. 33-35
C. Charles
D. none of the above

It is possible to use Ohm's Law to calculate I, E or R if two of the three are known.

C-11-f

75. Which of the following formula would be used to calculate amperage in resistive circuit?
A. $E=IR$
B. $R=EI$
C. $R=E/I$
*D. **$I=RE$** UABEM Pg. 33-35

I means intensity of current flow, current in amperes.

C-11-f

76. Capacitance represents a components ability to
A. conduct flow electrons
B. resist flow of electrons
*C. **store electrons** UABEM Pg. 83-87
D. create electrons

Capacitance is the property of an electric circuit which enables energy to be stored.

C-12 - Measuring Instruments

C-12-g

77. A meter with the capacity to measure very high resistances is call a?
- A. ammeter
 - B. digital voltmeter
 - C. analog voltmeter
 - *D. megger** UAHTM Unit 5, UABEM Pg. 67-123
- A megohmmeter is an instrument that can detect vary high resistances in millions of ohms.**

C-12-c

78. A technician would use a micron gauge to measure?
- A. suction pressure
 - *B deep vacuum** UAHTM Unit 5
 - C. discharge pressure
 - D. electric current
- A gauge used when it is necessary to measure pressure close to a perfect vacuum**

C-12-c

79. If a technician has set his VOM meter to R x 100 he would be measuring
- *A resistance** UAHTM Unit 5, UABEM Pg. 123-128
 - B. voltage
 - C. amperage
 - D. capacitance
- A VOM or multimeter is an instrument that will measure voltage, resistance, and milliamperes. The R x 100 scales refers to resistance.**

C-12-c

80. When checking resistance through a motor winding the proper instruments to use would be a/an?
- A. megger
 - B. voltmeter
 - C. ammeter
 - *D. ohmmeter** UAHTM Unit 5, UABEM Pg. 123-128
- An ohmmeter or VOM would be used to check the resistance of a motor winding.**

C-12-c

81. An ohmmeter will measure infinite resistance when testing an
- A. open fuse
 - B. open contacts
 - C. closed contacts
 - *D. both A and B** UAHM Unit 5, UABEM Pg. 123-128
- On any circuit that is open an ohmmeter will have an infinite reading**

C-12-a

82. If a technician has placed his VOM in parallel with an energized load he is probably checking?

- *A. voltage UABEM Pg. 43-55**
- B. resistance
- C. amperage
- D. Ohm's

Out of the above choices voltage would be checked across an energized load in parallel. In order to check resistance the power would need to be de-energized and the load isolated so the resistance could be checked. If you were checking amperage you would connect your VOM in series.

C-12-d

83. When a technician is checking unknown _____ he should always set the instrument to the highest scale to prevent damage to the meter.

- A. voltage
- B. amperage
- C. Ohm's
- *D. both A & B UABEM Pg. 123-128**

If you are using an analog instrument you should always set the instrument to the highest setting to start. Digital meters are more forgiving but it is still better to follow the same practice.

C-12-b

84. If a technician has placed his VOM in series with the load he is probably checking?

- A. voltage
- B. resistance
- *C. amperage UABEM Pg. 123-128**
- D. Ohm's

Out of the above choices amperage would be checked in series with an energized load.

C-12-g

85. Which of the following instruments would be used to check the condition of insulation on a motors windings?

- A. ammeter
- B. ohmmeter
- C. voltmeter
- *D. megohmmeter UAHTM Unit 5**

A megohmmeter is an instrument that can detect vary high resistances in millions of ohms and is used to detect the condition of a motor's winding insulation. As the insulation degrades the resistance will decrease.

C-13 - Electrical Circuits (Series and Parallel)

C-13-a

86. A ladder diagram can also be called
- A. a pictorial diagram
 - B. an oblique diagram
 - C. an orthographic projection
 - *D. electrical line wiring diagram UAHTM 15.8**
- A ladder or line diagram shows the power-consuming devices between two vertical lines**

C-13-a

87. A pictorial diagram will?
- A. use symbols that indicate function of equipment
 - B. emphasize "flow" of system
 - *C. show approximate location of electrical system components UAHTM 15.8**
 - D. not show approximate location of electrical system components
- A pictorial diagram shows the location of each component as it appears to the person installing or servicing the equipment.**

C-13-a

88. The primary and secondary windings in a transformer are wired in?
- A. series
 - B. parallel
 - *C. not connected electrically UABEM Pg. 99-102**
 - D. series-parallel
- A transformer is a device which has no moving parts and that transfers energy from one circuit to another by induction.**

C-13-b

89. What happens when the length of the path of an electrical circuit is decreased?
- A. there will be a no change in total circuit resistance.
 - B. there will be an increase in total circuit current
 - C. there will be an increase in total circuit resistance
 - *D. there will be a decrease in total circuit resistance UABEM Pg. 44-60**
- As an electrical circuit's path is decreased the resistance through the circuit will also decrease.**

C-13-a

90. What is the total amperage of a circuit when two 25 ohm resistors are connected in series using a 120 volt power source?
- A. 8 amps
 - B. 3.2 amps
 - *C. 2.4 amps UAHTM 12.12., UABEM Pg. 43-55**
 - D. 375 milliamps

In a series circuit the total resistance is added together to obtain a total.

C-13-a

91. If the voltage is the same across each load in a circuit it would be considered?
- *A. parallel circuit UAHTM 12.13, UABEM Pg. 43-55**
 - B. series circuit
 - C. series-parallel circuit
 - D. open circuit

In a parallel circuit the total voltage is applied across each resistance.

C-13-a

92. If a circuit is designed to allow the flow of electrons to follow only one path it would be?
- A. a series-parallel circuit
 - B. a parallel circuit
 - C. a series circuit
 - *D. rectifier circuit UAHTM 12.24, 17.25**

A rectifier allows current to flow in one direction. Because of this the output of a rectifier circuit is in one is in one direction thereby converting AC current to DC.

C-13-a

93. A line or ladder type diagram is most useful for?
- A. showing the physical positions of the systems components
 - *B. understanding circuit operation UAHTM 15.8**
 - C. doing the actual wiring
 - D. showing the color coding of wiring

A ladder or line diagram shows the power-consuming devices between two vertical lines which makes it easier to understand circuit operation.

C-13-a

94. If a technician took a reading across a normally closed set of contacts when a relay or contactor coil was de-energized the reading would be?

- *A. 0 volts** UABEM Pg. 123-128
- B. source voltage
- C. 0 ohms
- D. circuit amperage

When taking a voltage reading in series across a contact that is closed the voltage reading on the meter would read zero volts. If the contact was open the meter would read whatever the line voltage was.

C-13-a

95. An ohmmeter must never be connected to a

- A. series-parallel circuit
- B. parallel circuit
- C. a de-energized circuit
- *D. energized circuit** UABEM Pg. 123-128, UAECSSM Pg. 7

Ohmmeters are designed to read resistance in a circuit and there is the potential to damage the instrument if the leads are placed in contact with a circuit that is energized.

C-14 - Electric Service

C-14-a

96. If a 24 volt control transformer has a VA rating of 60 what is the maximum amperage rating?

- A. .06 amp
- B. .6 amp
- *C. 2.5 amp** UABEM Pg. 99-102
- D. 9.6 amp

VA stands for voltamperes. If you divide the rated voltage of the transformer into the VA you will get the amount of amps that the transformer can handle.

C-14-a

97. A technician has obtained the following resistance readings across the terminals on a single phase compressor: 8 ohms from T1 to T3, 3 ohms from T1 to T2, and 5 ohms from T2 to T3. Which terminals are RUN, START, and COMMON?

Use the example below to answer this question

A. T1 is Common

T2 is Run

T3 is Start

B. T1 is Start

T2 is Common

T3 is Run

C. T1 is Run

T2 is Start

T3 is Common

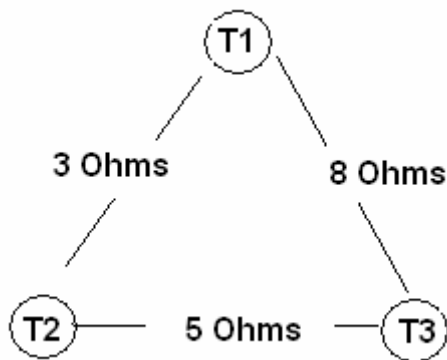
***D. T1 is Run UARSM V2 Pg. 515-516**

T2 is Common

T3 is Start

In a single phase motor the start winding will have a higher resistance than the run and if you take a reading across the run and the start terminal that reading will equal the sum of the two other readings.

See diagram below



C-14-a

98. The contacts of a current relay

A. use back voltage (EMF) from the run winding to operate

B. use back voltage (EMF) from the start winding to operate

***C. are normally open contacts UAHTM 17.19, UARSM V1 Pg. 291-292**

D. are normally closed contacts

The contacts of a current relay are normally open and close during lock rotor current.

C-14-b

99. A motor starter is also called a?

- *A. motor controller** UARSM V1 Pg. 311-321
- B. start relay
- C. current relay
- D. potential relay

A motor controller and a motor starter are different names for the same component.

C-14-a, b

100. If a relay coil is open the technician would read _____ when checking if with his ohmmeter

- A. infinite resistance
- B. zero resistance
- C. some resistance
- *D. Both A or B** UAHTM Unit 5, UABEM Pg. 123-128

On any circuit that is open an ohmmeter will have an infinite reading.

C-14-a

101. A sensor that uses a positive temperature coefficient thermistor (PTCT)

- A. decreases resistance as temperature increases
- *B. increases resistance as temperature increases**

<http://www.thermistor.com/>

- C. must be level for proper operation
- D. must be installed near a supply air register for proper operations

A semiconductor electronic device that changes resistance with a change in temperature.

C-14-a, b

102. These devices are used to protect electrical circuits from overcurrent

- A. relays and breakers
- B. contactors and fuses
- *C. fuses and breakers** UARSM V1, Pg. 276-277
- D. capacitors and relays

Fuses and breakers are designed to protect a load from over current. Breakers can be reset.

C-14-a

103. If two 30 μf run capacitors are wired in parallel what is the new microfarad rating on the circuit?

- A. 90 μf
- B. 15 μf
- C. 45 μf
- *D. 60 μf** UABEM Pg. 83-87

When calculating microfarad in parallel it is additive in nature the same as a resistor in series.

C-14-a

104. On a hermetic compressor what component is designed into the compressor to protect against excessive temperatures and overcurrent
- A. a fuse
 - B. a breaker
 - *C. an overload protector UAHTM 39.7**
 - D. a rectifier

In hermetic compressors the device that provides protection against over current and excessive temperatures is called an overload protector. This device can be externally or internally mounted

C-14-a

105. The contacts of a potential relay
- A. are normally open
 - *B. are normally closed UAHTM 17, 18, UARSM V1 Pg. 291**
 - C. activate by amperage from the run winding
 - D. activate by amperage from the start winding

The contacts on a potential relay are normally closed and open as the motor comes up to speed. Back voltage (EMF) from the start winding causes a small current to flow in the start winding and potential relay coil because they are in the same circuit.

C-14-a

106. A rectifier is used to?
- A. reduce the voltage in a circuit
 - B. increase the resistance in a circuit
 - C. convert direct current to alternating current
 - *D. convert alternating current to direct current UAHTM 12. 24**
- A rectifier is a device for changing alternating current to direct current.**

D: Controls

D-15 - Electrical Motors and Starting Components

D-15-d

107. The run windings of a motor have _____ turns as compared to the start windings.

- *A. fewer **UAHTM 17.5-17.6**
- B. more
- C. the same number of
- D. an infinite number of

The run winding is wound with a larger diameter wire than the start winding and have fewer turns.

D-15-d

108. On a typical split-phase electric motor the start winding circuit is de-energized as it

reaches approximately _____ of its operating speed?

- A. 50%
- B. 65%
- *C. 75% **UAHTM 17.5**
- D. 90%

When the motor reaches approximately 75% of its normal speed the start winding is removed from the circuit.

D-15-i

109. What component wired in series with the start windings on a single phase motor will create greater starting torque.

- *A. a capacitor **UAHTM 17.12-17.13**
- B. a transistor
- C. a rectifier
- D. a thermistor

The start capacitor is wired in series with the start windings to give the motor more starting torque. The capacitor is chosen to make the phase angle such that it is most efficient for starting the motor.

D-15-e

110. A three-phase motor does not have

- A. start windings
- B. a start capacitor
- C. a start relay
- *D. all of the above **UAHTM 17.16**

Three phase motors have no starting windings, capacitors, or relays. They can be thought of as having three separate single phase power supply's.

D-15-i

111. A start component that is rated in microfarad would be a
- *A. capacitor UAHTM 17.13**
 - B. thermistor
 - C. transistor
 - D. rectifier

All capacitors are rated in microfarads.

D-15-b

112. What effect will a higher supply voltage have on the current draw of an electric motor?
- A. it will be lower than it should be
 - B. it will remain the same
 - *C. it will be higher than it should be UAHTM 19.2**
 - D. it will be erratic

Based from Ohm's Law as voltage goes up current will go down.

D-15-b

113. With an electric motor running normally the amperage reading would be called?
- A. full-load amperage
 - *B run-load amperage UAHTM 19.2**
 - C. locked-rotor amperage
 - D. operating amperage

Run load amperage is also referred to as the full load amperage and is the current drawn while the motor is running.

D-15-g

114. If a technician uses an ohm meter to check the windings of an electric motor and records an infinite reading on the start windings this would indicate?
- A. the start winding is shorting to ground
 - B. the start winding is shorting to the run winding
 - C. the start winding is shorting to itself
 - *D. the start winding circuit has an open somewhere**

On any circuit that is open an ohmmeter will have an infinite reading.

D-15-i

115. What device would be discharged using a 20,000-ohm, 5 watt resistor?
- *A. capacitor UAHTM 17.13, UAECSTSG Pg. 29**
 - B. thermistor
 - C. transistor
 - D. rectifier

The safest way to discharge a capacitor is by using a 20,000-ohm, 5 watt resistor.

D-15-b

116. The run-load amperage on an electric motor is typically

- A. ½ that of the locked-rotor amperage
- B. 1/3 that of the locked-rotor amperage
- *C. 1/5 that of a full-load amperage UAHTM 18.2**
- D. 1/10 that of full-load amperage

Normally the LRA of a motor is about five times the RLA.

D-15-h

117. What device is used to energize another load such as a contactor or motor starter with in turn would start or stop a motor.

- A. a switch
- B. a circuit breaker
- C. a line fuse
- *D. a pilot duty relay UAHTM 19.3**

Pilot duty relays can switch larger contactors or starter on or off.

D15-h

118. A magnetic coil and electrical contacts are the primary components of this electrical device?

- A. a centrifugal switch
- B. a circuit breaker
- C. a thermal overload
- *D. a contactor UAHTM 19.4**

A contactor is a larger version of a relay and can be rebuilt . The magnetic holding coil can be designed for various operating voltages.

D-15-h

119. A magnetic coil, overload protector and electrical contactors are the primary components of this electrical device

- A. a circuit breaker
- B. a thermal overload
- C. a contactor or relay
- *D. a motor starter UAHTM 19.5**

A motor starter is similar to a contactor but also includes overload protections.

D-15-d, e

120. An electric motor that has an internal overload would have a?

- A. circuit breaker
- *B. a thermal device buried in the motor windings UAHTM**

25.22

- C. line fuse
- D. none of the above

If a motor is designed with an internal overload the device will be buried in the motor windings and open if the temperature exceeds a predetermined limit.

D-15-d, e

121. What device could be used as external protection for a motor?

- A. a line fuse
- B. a circuit breaker
- C. an external overload

***D. all of the above** UAHTM 19.6-19.8, 39.7, UARSM V1 Pg.

276-277

Any of the items listed above could be used to protect a motor from over current, however the external overload would also protect against over heating.

D-15-e

122. What type of motor would a technician switch any two legs on to reverse the rotation of the motor?

- A. CSIR
- B. CSCR
- C. PSC

***D. Three Phase**UAHTM 17.16

The direction of a three phase motor can be changed by reversing any two legs of the circuit. The direction of the other types of single phase motors cannot be changed externally.

D-16 - Automatic Controls and Devices

D-16-i

123. A technician could install this type of component on a refrigeration system that has multiplexed circuits to

A. prevent the evaporator temperature on a multiplexed system from getting too high

***B. prevent the evaporator temperature on a multiplexed system from falling too low**
UAHTM 25.4

C. prevent the suction pressure on a multiplexed system from getting too high

D. prevent the suction pressure on a multiplexed system from getting too high

An EPR valve is a mechanical control that keeps the refrigerant pressure in the evaporator from going below a predetermined point.

D-16-i

124. A technician would set this device by the RLA on the refrigeration compressors

- *A. crankcase pressure regulator UAHTM 25.7**
- B. evaporator pressure regulator
- C. thermal expansion device
- D. automatic expansion device

A CPR valve is used to keep the low temperature compressor from overloading on a hot pull-down.

D-16 -i

125. A technician would set this device by calculating the evaporator superheat.

- A. automatic expansion device
- B. evaporator pressure regulator
- C. low pressure control
- *D. thermal expansion device UAHTM 24.2, UARCM Pg. 1-13,**

43-51

A thermal expansion valve meters the refrigerant to the evaporator using a thermal sensing element to monitor the superheat.

D-16-i

126. What device is used to reduce the suction temperature of the compressor?

- *A. desuperheating TXV UARCM Pg. 88-92**
- B. balance port TXV
- C. pressure limiting TXV
- D. pressure balancing TXV

A desuperheating TXV is used in conjunction with hot gas bypass to control the temperature of the suction gas returning to the compressor.

D-16-g

127. If a technician needs to control the head pressure on a refrigeration unit within tight limits the best device to employ on the condenser fan motor would be?

- *A. a variable frequency drive (VFD) UAHTM 22. 18**
- B. a modulator
- C. a headmaster control
- D. fan cycling

Variable speed condenser fan motors used on larger condensing units can vary their speed gradually according to head pressure or outside ambient changes.

D-16-i

128. The EPR valve is installed between the?
- A. suction accumulator and the compressor
 - B. liquid line and the evaporator
 - C. evaporator and the suction accumulator
 - *D. A or C UAHTM 25.4**

An EPR can be installed anywhere in the suction line of the refrigeration system.

D-16-d

129. Which of these devices would be considered a low ambient temperature head pressure control used on an outdoor unit?
- A. CPR
 - *B. fan cycling UAHTM 25.11**
 - C. EPR
 - D. off-cycle defrost

Fan cycling is used to help maintain a more constant head pressure in areas where outside ambient temperatures vary.

D-16-i

130. If a technician wanted to protect a refrigeration system from operating under excessive head pressure situations he would install a/an
- A. evaporator pressure regulator
 - *B. head pressure control UAHTM 22.18**
 - C. crankcase pressure regulator
 - D. low pressure control

Head pressure controls are used as safety devices in the event that the condenser is not able to reject required amount of heat from the refrigerant gas.

D-16-i

131. The following device would use a pressure transducer to sense net oil pressure, electronic oil safety controllers use a
- A. pressure gauge
 - B. thermal expansion device
 - C. mechanical oil safety control
 - *D. electronic oil safety control UAHTM 14.13**

An electronic oil safety control used a pressure transducer to sense net oil pressure.

D-16-j

132. If a technician needed high accuracy it would be best to select a device that employed the following sensing element if available
- A. a helical bimetal
 - B. a refrigerant filled sensing element
 - C. a snap disc bimetal
 - *D. a thermistor <http://www.thermistor.com/>**

A thermistor semiconductor electronic device that changes resistance with a change in temperature.

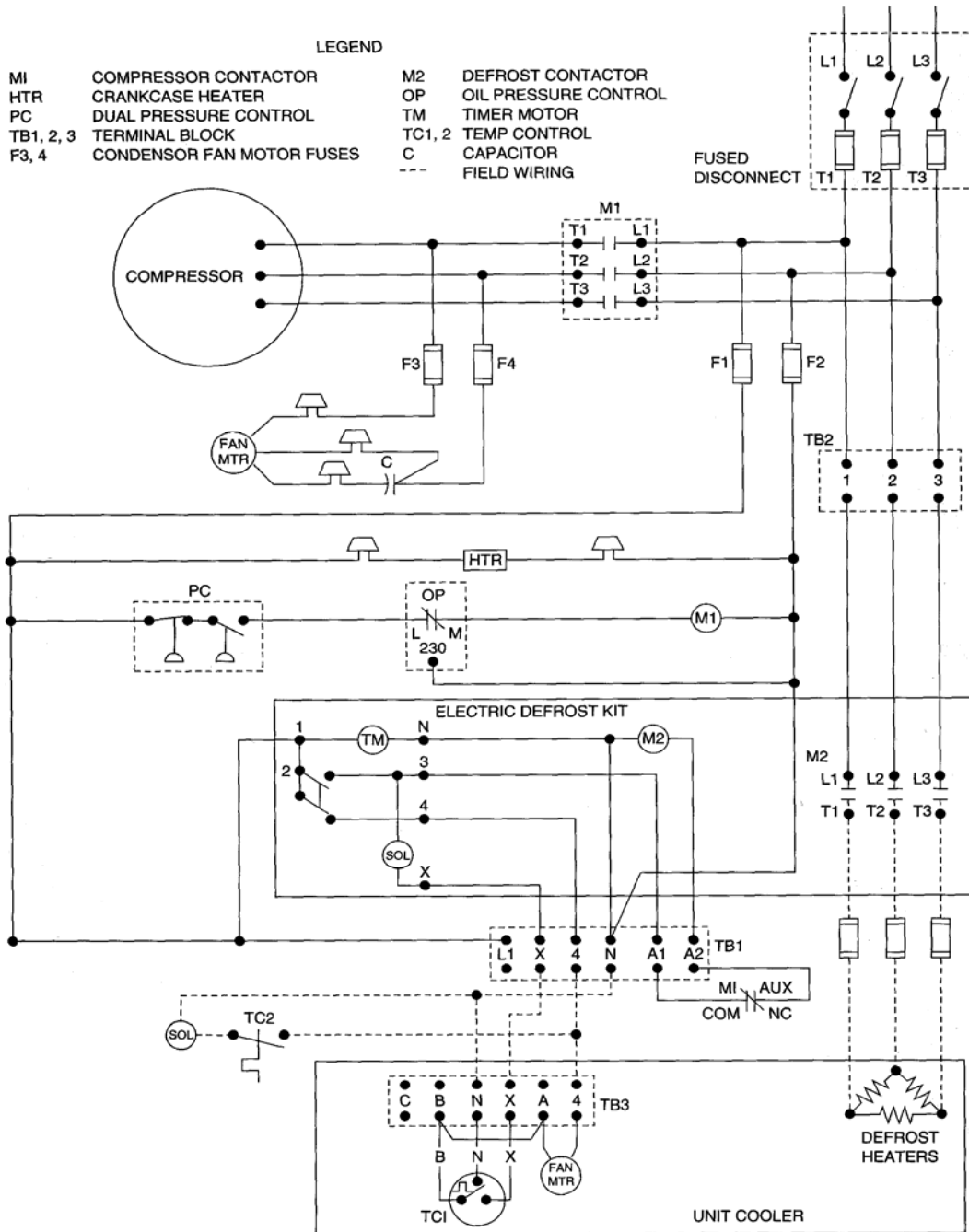
D-16-f, g

133. If a technician installed a low-pressure switch, a liquid line solenoid valve, and a thermostat in a refrigeration system what kind of circuit would have been designed?
- A. a hot gas bypass circuit
 - B. a hot gas defrost circuit
 - *C. automatic pump down cycle UAHTM 25.19**
 - D. manual pump down cycle

An automatic pump down cycle consists of a normally closed liquid line solenoid valve installed in the liquid line of a refrigeration system and controlled by a thermostat.

D- 17 - Electrical Troubleshooting

Use this diagram to answer the next five questions (134-138)



D-17-a

134. The compressor on a walk-in freezer has just restarted after a defrost cycle but the technician notices that the evaporator fans are not operating. What would the first component that the technician would focus on in this situation?

- A. the evaporator fan since it has obviously failed
- B. the defrost timer since the contacts powering terminal 4 have obviously failed
- C. check for voltage at the unit cooler at terminals A and 4

***D. the defrost termination switch UAHTM 25.30**

The defrost thermostat (TCI) has two functions. When the unit coolers internal temperature around the evaporator reaches a temperature above 32°F the contacts between B and X will be made and the X terminal on the defrost timer will energize the defrost termination solenoid. This will open the connections between B and N. Once the unit goes back into refrigeration the defrost thermostat will have to cool below 32°F before the contacts between B and N close allowing the circuit to the evaporator fan to be made.

D-17-a

135. If the liquid line pump-down solenoid is leaking slightly what would the most obvious symptom be?

- A. the compressor would not shut-down
- B. the compressor would not start
- *C. the compressor would short cycle**
- D. there would not be a symptom

UAHTM 25.19

If the liquid line solenoid is leaking high pressure liquid will pass through the solenoid flashing to a gas on the other side. This in turn will cause the pressure on the low side of the system to rise causing the low pressure control to energize the compressor.

D-17-a

136. What terminal on the defrost timer is used to terminate the defrost cycle early if all of the ice has been melted from the evaporator coil?

- A. terminal 3
- B. terminal 4
- *C. terminal X**
- D. terminal N

UAHTM 25.29

When X terminal on the defrost timer has power applied to it a small solenoid is energized and the defrost cycle is terminated early

D-17-a

137. What do terminals L1 and N provide for at the defrost timer?

- A. power for the defrost motor
- B. power for the liquid line pumpdown solenoid
- C. power for the evaporator fans

***D. all of the above UAHTM 25.29**

L1 and the neutral leads provide the electrical power to all of the items for the defrost motor, liquid line pump down solenoid and the evaporator fans.

D-17-b

138. At what terminal is the electrical interlock between M1 and M2 wired in this diagram?

***A. A1 and A2 UARSM Pg. 373**

B. B and X

C. 4 and N

D. there is not an electrical interlock device in this schematic

The A1 and A2 terminals provide the terminal connections for the normally closed M1 auxiliary contact. When closed this contact allows the circuit between 3 and N to be complete thus allowing M2 to be energized when the defrost timer contacts between 2 and 3 are closed.

E: Rack Systems

E-18 - Demonstrate General Knowledge of Rack Systems

E-18-a

139. Large or small compressors on parallel compressor racks, which are usually dedicated to the coldest cases, are called?

- A. satellite compressors
- B. remote compressors
- C. booster compressors

***D. both A and C UAHTM 26.6**

On a parallel rack if there are compressors that run at a different suction temperature from that of the main rack they are called satellite or booster compressors.

E-18-b, c, g

140. What is a true statement regarding the operation of a parallel rack system?

- A. it allows for better temperature control than a single condensing unit
- B. it allows for multiple evaporator temperatures to be maintained
- C. it allows for greater operational safety versus a single condensing unit

***D. all of the above UAHTM 26.06**

Parallel rack systems allow for better temperature control, allow for multiple evaporators to be operated and provide a greater degree of operational safety than single condensing units.

E-18-b

141. Why is it important for the oil separator to be sized properly, insulated and located as close to the compressor as possible?

- A. to minimize the chances of refrigerant vapor to condense into liquid between the condenser and the receiver
- B. to minimize the chances of refrigerant vapor to condense into liquid between the evaporator and the compressor
- C. to minimize the chances for liquid refrigerant to vaporize inside the separator

***D. to minimize the chances for refrigerant vapor to condense into liquid inside the separator UAHTM 25.46**

The oil separator is used to capture the oil from the discharge of the compressor and return it to the compressors on the refrigeration rack however it cannot distinguish between refrigerant oil and liquid refrigerant so if refrigerant is allowed to condense in the oil separator it will be returned to the compressor along with the oil. This situation will cause an oil dilution problem that can damage the compressors over a period of time.

E-18-b

142. The capacity that a parallel rack will have during operation is determined by?

- *A. the coldest temperature evaporator UAHTM 26.06**
- B. the medium temperature evaporator
- C. the warmest temperature evaporator
- D. None of the above

The suction on a parallel rack must be operated to meet the temperature requirements of the lowest lineup on the rack.

E-18-d

143. On a parallel compressor rack what device is used to control multiple evaporators?

- A. CPR
- B. LPC
- *C. EPR** **UAHTM 26.06**
- D. HPC

As mentioned in question 142 the suction on a parallel rack must be operated to meet the temperature requirements of the lowest lineup on the rack. Because of this any lineup that needs to operate at a suction higher than that lowest temperature lineup must have an evaporator pressure regulator installed on it.

E-18-f

144. What can cause the suction pressure on a parallel rack system to run higher than its setpoint?

- A. a lower than design system load
- *B. a higher than design system load** **UAHTM 26.05**
- C. a lower than design outside ambient temperature
- D. multiple dirty evaporators

If the overall load on the parallel rack is greater than the design capacity the suction pressure on the rack will not be able to be maintained and the suction pressure of the system will rise until it reaches the point where the compressor capacity and the system load balance out.

E-18-b

145. Auxiliary contacts would not be used to?

- A. control a compressor
- B. control a crankcase heater
- C. control an interlock circuit
- *D. both B and C** **UAHTM 19.4**

Auxiliary contacts could be used on a crankcase heater or a interlock switch but they would not be used to control a compressor.

E-18-d

146. What device would be used to cycle the condenser fans on and off as system head pressure changes?

- A. a reverse acting low- pressure control
- B. a direct acting low-pressure control
- *C. a reverse acting high-pressure control** **UAHTM 25.11**
- D. a direct acting high-pressure control

A reverse acting high-pressure control would be used to cycle condenser fans on and off as needed to maintain a relatively stable system head pressure as ambient conditions change.

E-19 - Install and Maintain Oil Control Systems

E-19-b

147. A device used to damper out compressor torque to the connected copper piping is a

- A. torque stopper
- B. vibration enhancer
- C. vibration deliminator
- *D. vibration eliminator**

UAHTM 25.47

Vibration eliminators are used to reduce compressor vibrations to connect piping during operation and to minimize torque on connected piping during start up and shut down.

E-19-d

148. A device used to maintain a minimum oil condition in a parallel rack compressor is

- A. oil separator
- B. oil reservoir
- *C. oil level control**
- D. oil filter

UAHTM 26.6

All the components listed above are parts that make up an oil control system and the oil level control is the device in that system that controls the oil level in each compressor.

E-19

149. To maintain the correct amount of oil in each compressor on a parallel rack an oil system would require this/these components:

- A. oil separator
- B. oil reservoir
- C. oil level regulator
- *D. all of the above**

UAHTM 26.6

All three of the above listed components would be required to have a fully functioning oil control system.

E-19

150. What device is used on an oil system on a parallel to control the pressure of the oil feeding the oil regulator?

- A. a purge valve
- B. a solenoid valve
- *C. pressure differential valve**
- D. an oil pressure valve

UAHTM 26.6

A pressure differential valve is used to control the pressure feeding the oil level controls on a compressor from between 5 to 20 PSI.

E-19

151. What is the best method for precharging an oil separator?
- A. put it through the discharge line
 - B. put it through the suction line
 - C. put it through return line from condenser
 - *D. charge the oil directly into the separator before brazing into place**

www.henrytech.com/Tips/HT-TT6.pdf

The best method for charging an oil separator is to fill it to the recommended level before brazing it into place.

E-19

152. A decrease in suction pressure of a reciprocating compressor will result in:
- A. a decrease in the temperature of the discharge gas
 - B. an increased cooling of a hermetic compressor motor
 - C. a decrease in required compressor displacement
 - *D. a decrease in volumetric efficiency UARSM Pg. 393**
- Refrigerant oils will start to break down at 325 °F. At this temperature carbonization can start to collect on discharge valve surfaces.**

E-20 - Add Liquid Subcooling

E-20-a

153. For every 1°F of additional liquid subcooling a systems capacity will be increased by approximately?
- A. ½%
 - *B. 1% UAHTM 3.10, 48.13-15**
 - C. 2%
 - D. 3%

Additional liquid subcooling will increase system capacity in a refrigeration system by reducing the percentage of refrigerant that flashes off as the refrigerant enters the evaporator

E-20-a

154. These lines should be insulated to help maintain subcooling
- A. suction line
 - B. discharge line
 - *C. liquid line UAHTM 3.9**
 - D. compressor

In order to maintain the temperature of the liquid in the liquid line insulation should always be applied if the line will be in an area where the ambient temperature is above the temperature of the liquid

E-20-b

155. Additional liquid subcooling

- A. increases the amount of flash gas at the outlet of the TXV
- B. maintains the amount of flash gas at the outlet of the TXV
- *C. reduces the amount of flash gas at the outlet of the TXV**

UAHTM 3.10

- D. has no effect on the amount of flash gas at the outlet of the TXV

The closer that the liquid refrigerant feeding the expansion device is to the suction temperature the lower the percentage of flash gas will be.

E-20-a, b

156. What is the purpose of a mechanical subcooling loop on a parallel rack system?

- A. reduce the temperature of the liquid entering the metering device on the system performing the subcooling
- B. reduce the temperature of the liquid entering the metering device on the system being subcooled
- C. increase the capacity of system to which the liquid is being subcooled

***D. both B and C**

www.packless.com/subcool/subcool.html

The purpose of a mechanical subcooling loop is to reduce the temperature of the liquid so there will be less flashing of the refrigerant as it flows through the TXV therefore more refrigerant will be available to absorb heat from the process.

E-21 - Perform Basic Service on "Rack" System

E-21-a

157. Inadequate liquid sub cooling in a system can cause?

- A. excessively high evaporator superheat
- B. excessively low evaporator
- C. excessively high discharge temperatures

***D. both A and C UAHTM 3.10, 29.11**

If liquid subcooling is inadequate this could result in excessively high evaporator superheat due to a higher than normal percentage of flash gas at the inlet to the evaporator. This in turn could cause high return gas temperatures to the compressor thus resulting in high discharge temperatures at the compressor.

F: Self-contained Units

F-22 - Metering Devices

F-22-a

158. What device would be considered a non-modulating expansion device?

- *A a capillary tube UAHTM 3.10, 24.29
- B. a pressure gage
- C. a filter
- D. a metering device

A capillary tube is a fixed orifice device that meters refrigerant based on the pressure differential between the high and the low side of the system. It cannot adjust its flow based from evaporator superheat like a TXV device.

F-22

159. A CPR valve is used to protect the compressor from?

- A. low load pull-downs
- B. high load pull-downs
- C. amperage load over RLA
- *D. both B and C UAHTM 25.7

A crankcase pressure regulator protects the compressor from potential RLA over amperage during high load pull-down.

F-22-a

160. What happens to the gauges if there is a high refrigerant charge in a system using a capillary tube?

- *A both the suction and discharge gauges will indicate a high pressure UAHTM 45.23

- B. both the suction and discharge gauges will indicate a low pressure
- C. the suction gauges will indicate a higher-than-normal reading and the discharge

gauges will indicate a lower-than-normal reading

- D. the suction gauges will indicate a lower-than-normal reading and the discharge

gauges will indicate a higher-than-normal reading

On a capillary system that is overcharged both the high and low side will read a higher than normal pressure. This is due to the fact that as the system charge is increased the liquid refrigerant will back up into the condenser producing a higher condensing pressure. This in turn will force more refrigerant into the evaporator side of the system increasing its pressure.

F-22-a

161. An overcharge with this type of device will cause a decrease in evaporator superheat?

- *A. capillary tube **UAHTM 3.10, 24.39**
- B. restrictor plate
- C. TXV
- D. both A and B

An overcharge of a capillary system or a restrictor plate will cause the head pressure on the system to increase thus pushing more refrigerant through the metering device. This will cause the superheat at the end of the evaporator to decrease.

F-23 - Charging Procedures

F-23-a, b

162. The liquid receiver service valve could be used to?

- *A. charge refrigerant into the system
- B. remove refrigerant for the system
- C. stop the flow of refrigerant for system pump down purposes
- *D. all of the above **UAHTM 3.10, 24.29**

A liquid receiver is a storage vessel that could have refrigerant charged into it during the initial charging of the unit, a technician could also remove refrigerant from the system at that point, and the system could also be pumped down into it by closing off the outlet valve.

F-23-f

163. A technician may need to bypass this control when charge a system

- A. compressor overload
- B. thermostat
- C. HPC
- *D. LPC **UAHTM 14.12, 25.18**

On initial start up of a piece of equipment that has a low pressure control designed into it or if a system is low on refrigerant it may be necessary for the technician to bypass the LPC so that he can get the compressor started and draw refrigerant into the system.

F-23-b

164. When charging liquid refrigerant into a compressor care must be taken because?

- A. refrigerant may fractionate
- B. damage to the compressor may occur by liquid slugging
- C. it is easier to overcharge the system
- *D. both B and C**

UAHTM 10.3

Anytime a technician charges liquid into a system from the low side instead of vapor there must be great care taken to make sure that the compressor does not get a liquid slug. Also it is much quicker to charge in a liquid therefore it is easier to overcharge a system if the technician is not careful.

F-23-b

165. Low suction pressure and under cooling can be caused by?

- A. excessive head pressure
- B. high suction pressure and insufficient cooling
- C. defective compressor
- *D. undercharged system**

UAHTM 45.22

If a refrigeration system is undercharged the cooling performance will be low and the suction pressure will also be below normal operating conditions.

F-23-b

166. What type of refrigerants must be charged into a system in a liquid form?

- A. zeotropic refrigerants
- B. near azetropic refrigerants
- C. azetropic refrigerants
- *D. both A and B**

UAHTM 9.10, 10.8

Both Zeotropic and near Azetropic refrigerant must be charged from their main cylinders in a liquid form to prevent fractionation. When doing this operation, it is recommended to use some type of expander device between the tank and the unit to ensure that liquid is entering the unit.

F- 24 - Preventative Maintenance on Self-contained Unit

F- 24

167. A low pressure switch can be used to?

- A. initiate an off defrost cycle
- *B. control frost build-up on the coil UAHTM 14.12, 25.18**
- C. protect against high suction pressures on the low side
- D. both A and B

A low pressure control can be set up to shut the compressor off in the event the coil temperature drops below freezing. This would be used on units that normally run at a suction pressures causing temperatures above freezing but under low load conditions could run below freezing thus causing ice to form on the coil.

F-24

168. What device is used to shut the compressor off if the suction falls below a given set point?

- A. HPC
- *B LPC UAHTM 14.12, 25.18**
- C. EPR
- D. CPR

Low pressure controls are commonly used to cycle compressors on and off to provide temperature control for a refrigerated fixture.

F-24

169. What device is used to prevent refrigerant migration to the compressor during the off cycle?

- A. a crankcase heater
- B. a suction accumulator
- C. a pump-down cycle
- *D. A or C UAHTM 25.19, 25.49**

A crankcase heater or a pump down cycle can be used to prevent the migration of refrigerant to the crankcase of the compressor during the off cycle.

G: Ice Machines

G-25 - Clean and Sanitize the Machine

G-25-d

170. On an ice machine the flush cycle is designed to?

- *A. remove mineral build-up in the water** **UAHTM 27.2**
- B. flush the holding bin
- C. chemically treat the water
- D. sanitize the ice cube trays

During the ice building process water is pumped over the ice plates and the water freezes to the plates but the minerals in the water do not. This means that as the cycle progresses the mineral content in the water in the reservoir continues to build up. The flush cycle on an ice machine is designed to purge that mineral concentrated water from the reservoir on a scheduled basis.

G-25-c

171. Carbon filtration is used to?

- A. sanitize the water
- B. remove minerals from the water
- *C. remove chemicals from the water** **UAHTM 27.6**
- D. de-ionize the water

Carbon filters are used to remove certain chemicals from the water to improve the taste of the ice cubes.

G-26 - Service Ice Machine

G-26-h

172. The flaky coating that can build up on the surface of the evaporator on an ice machine is called?

- A. hardness
- B. sediment
- *C. scale** **UAHTM 27.6**
- D. turbidity

Scale is the flaky coating that builds up on the surfaces of the evaporator decreasing the efficiency to which the machine can produce ice.

G-26

173. How is the ice harvest accomplished on most ice machine?
A. by shutting the compressor off
B. by running hot water over the evaporator
***C. by hot gas defrost UAHTM 27.3**
D. by electric defrost

Most modern commercial ice machines use hot gas from the compressor discharge diverted directly to the evaporator to heat the ice plates thus allowing the cubes to be released from the plates.

G-26-f, g, h

174. What could cause an ice machines capacity in #'s per hour to be reduced?
A. excessive mineral deposits on the evaporator plate
B. dirty condenser coil
C. higher than normal entering water temperature
***D. any of the above UAHTM 27.2-27.9**

All three of the above items would cause an ice machines capacity to be reduced. Mineral deposits decreasing the efficiency of the evaporator plate, dirty condenser reducing the systems ability to reject system heat, and high entering water temperatures increasing the time of each ice harvest because of the additional heat removal required.

G-26-c, d

175. Sand and dirt in water are usually easily removed by?
***A filters UAHTM 27.6**
B. reverse osmosis
C. distillation.
D. de-ionization

If a compressor becomes inefficient the symptoms will be low high side pressure and high low side pressure.

G-26

176. As its temperature decreases, a/an ____ will decrease its resistance.
***A. PTC thermistor <http://www.thermistor.com/>**
B. NTC thermistor
C. cathode
D. Anode

A positive temperature coefficient thermistor will react by decreasing its resistance as the temperature of the device decreases.

H: Auxiliary Systems

H-27 - Hot Water Heat Reclaim Systems

H-27-b

177. What type of valve is used to direct hot gas from the condenser to the reclaim coil?

- A. a desuperheating valve
- B. a three way reversing valve
- C. a two way heat reclaim valve
- *D. a three way heat reclaim valve UAHTM 26.5**

A three way reversing valve is used in a refrigeration system to allow hot refrigerant gas to be diverted to a secondary condenser in the duct work of the HVAC system or a hot water tank.

H-27-d

178. What is the media that is heated by a heat reclaim system?

- A. air
- B. water
- C. refrigerant
- *D. A and B UAHTM 22.20-22.22**

In a heat reclaim system either water, air, or both could be heated.

H-27-d, g, h

179. Why is a heat reclaim system so important?

***A. it allows heat to be recaptured from the refrigerant stream and reused.**

UAHTM 22.20-22.22

- B. it allows for reduced system refrigerant charges
- C. it allows for reduced receiver sizes
- D. all of the above

Heat reclaim systems increase the overall efficiency by recovering heat that would otherwise be rejected outside of the building.

H-28 - Defrost Systems

H-28-e

180. What is the function of a timer release solenoid?

- A. initiate the defrost cycle
- B. maintain the defrost cycle
- *C. terminate the defrost cycle UAHTM 25.29, 25.30**
- D. none of the above

A timer release solenoid is used to terminate the defrost cycle earlier in the event that ice on the coil clears before the time out that is set on the clock.

H-28-e

181. What component energizes the electric defrost heater on a 24-hour defrost timer?

- *A. a normally open set of contactors** **UAHTM 25.30**
- B. a normally closed set of contactors
- C. the timer motor
- D. the timer initiation solenoid

Terminal 3 on a defrost clock has a normally open set of contacts that close when the timer goes into a defrost cycle. That closed set of contacts energize the defrost circuit directly or through a set of contacts.

H-28-e

182. On an electric defrost system what device initiates the de-energizing of the heater if the evaporator temp rises above freezing before the timed defrost cycle ends?

- *A. termination thermostat** **UAHTM 25.30**
- B. timer release solenoid
- C. defrost timer
- D. case thermostat

The defrost termination thermostat will close allowing the connection to the x terminal on the defrost timer clock to energize the timer release solenoid thus terminating the defrost cycle prior to the normal time out cycle.

H-28-b

183. What would the best method of defrost be for a fixture that has a case temperature below freezing and is operated by a single condensing unit located in a low ambient condition?

- A. hot gas defrost
- *B. electric defrost** **UAHTM 25.29, UARSM Pg. 430-432**
- C. forced defrost
- D. off cycle air defrost

Electric defrost would be the best choice since in low ambient conditions the condenser would have limited heat available for a hot gas defrost.

H-28-b

184. What is the BTU output of an electric defrost heater that is rated at 1200 watts?

- A. 5118 BTU's
- *B. 4096 BTU's**
- C. 4500 BTU's
- D. 4000 BTU's

UAHTM 2.14

1200 watts x 3.413 Btu's per watt would equal 4096 BTU's.

H-28-b

185. What would the best method of defrost be for a fixture that had an evaporator temperature below freezing but a case temperature above freezing?

- A. hot gas defrost
- B. electric defrost
- C. forced defrost
- *D. off cycle air defrost**

UAHTM 25.24, UARSM Pg. 428-430

If a case has a operating temperature above freezing it would be feasible to turn the refrigeration system off and allow the air in the fixture to melt the frost off the coil.

H-28-b

186. On a supermarket rack employing hot gas defrost where would the hot gas solenoid valve be installed?

- A. between the liquid receiver and the liquid header
- B. between the discharge line and the receiver
- C. between the liquid return line and the receiver
- *D. between the discharge line and the oil separator**

UAHTM 25.28, UARSM Pg. 432-435

The hot gas solenoid valve would be installed after the discharge line of the compressor so that the hottest possible gas could be sent out to the fixture for defrosting purposes.

***Note: If the system employs an oil separator the valve should be placed between that component and the condenser.**

I: Business and Customer Relations

I -29 – Establish Customer Relations

I-29-h, i

187. If you find yourself at odds with a confrontational customer, you should
- A. tell the customer you're not being paid to be a whipping post, pack your tools and leave.
 - B. tell the customer that you're not going to take his abuse, but try finishing the job.
 - C. defend yourself by telling the customer that it's not your fault and try to finish the job.
 - *D. keep your cool, learn as much as possible about the customer's complaint, continue working if possible, but call your supervisor to report the incident UACSS Pg. 40**
When faced with a difficult customer your first objective is to not escalate the situation. In this case listen to customer and avoid getting into a verbal sparring match. If possible, try to finish the work that you have been called to perform. Let your supervisor know about the incident.

I-29-d

188. When entering a customer residential premises you should always
- A. wipe your feet on their rug to make sure you shoes are clean
 - B. remove your shoes at the door
 - *C. place a clean pair of disposable covers over your shoes UACSS Pg. 13**
 - D. let the customer know that you have checked your shoes and they are clean
- When entering a customers home you should always place shoe/boot covers on to protect floors from potential tracking of dirt, oil or grease.**

I-29-m, n

189. If the technician is on a service call and notices another potential problem not related to the current work order, what should the technician do?
- A. don't bother to mention it and go ahead and repair it if you can do it quickly and it won't cost anything
 - B. generate a service ticket and replace the component
 - C. ignore it and hope that it turns into another service call for your company
 - *D. discuss what you have found with the customer and your supervisor so that the customer can decide whether to authorize the additional repair UACSS Pg. 47-49**
It is always best to clear any additional work through the customer before going ahead with the repairs.

I-31 – Keep Records, Document Work Performed

I-31-c

190. Which of the following is a required part of the work order?
- A. wholesale cost of parts used
 - B. form completed in legible hand writing
 - C. complete list of materials used and amount of time spent on the job
 - *D. both B and C UACSS Pg. 47**

The wholesale cost of the parts used on a job would not be listed on the work order.

I-31-C

191. Getting the customer to sign the work order should be
- A. the first thing you should do before starting the work
 - *B. the last thing that you should do before leaving the job UACSS Pg. 47**
 - C. could be done at any time
 - D. either A or B

After all work at the job has been completed and you have explained to the customer what repairs were preformed you should request that the customer sign the work order acknowledging the work that was done.

I-32 – Exhibit Professionalism

I-32-k

192. Which of the following is a part of your responsibility relative to your work crew?
- A. keeping to yourself and not bothering others
 - B. worrying about what others have been assigned to do by the supervisor
 - *C. working safely on the worksite UAHTM Unit 4**
 - D. keeping to yourself and not bothering others

As an integral part of a work crew you have a responsibility to interact with the other individuals in a positive, cooperative and safe manner.

I-32-c

193. You are called to a job site to perform some maintenance work on a system and after you are finished the customer approaches you and offers to pay you cash directly to perform some additional work. In this situation it would be ok to?

- A. accept the offer but tell him you will have to come back with your own truck and tools
- B. negotiate with the customer to see if you can get him to increase his offer
- C. accept the offer, but tell the customer that this is the only time that you will be able to help him out

***D. refuse the offer politely and if it happens again notify your supervisor of the situation UACSS Pg. 38**

In this situation it is important to politely tell the customer “No you would not be interested”.

I-32-p

194. What should the technician do in a situation where he is working on a refrigeration system that operates a case that holds perishable food items, the compressor has failed, it is 5:00 on a Monday evening, and it will take a few additional hours to repair the rack?

- A. leave the job site, go to dinner, and return after dinner to complete the job
- B. request authorization from the customer to leave the job to go to dinner telling him that you will return that evening to finish the job
- *C. request authorization from the customer to stay on the job until it is finished that evening UACSS Pg. 35**
- D. request authorization from the customer to leave the job telling him that you will return first thing in the morning to finish the job

In a situation where there is a critical application where there could be potential for monetary losses it is important that the repairs be completed as quickly as possible. With that in mind a request should be made to continue working until the system is repaired and operational.