Tertiary and Vocational Education Commission

Refrigeration and Air Conditioning Technology- Part I

NCT Equivalence Examination

1.

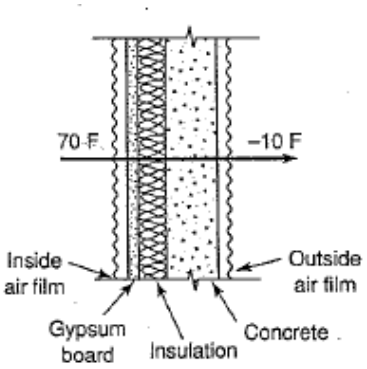
i. What are the common sources of heat which supply the load on refrigerating equipment? (04 Marks)

ii. In commercial refrigeration, the total cooling load is divided into four separate loads, what are they? (04 Marks)

iii. The exterior wall of a building is constructed of 200 mm. sand and gravel aggregate concrete (not oven dried), 75 mm insulation, and 12 mm. gypsum board. The wall is 22 m long by 5 m high. The indoor and outdoor temperatures are 28 ºC and -22 ºC. Find the U-value (overall heat transfer coefficient) for the wall and what is the heat transfer through the wall?

(***Inside air film R = 0.68, Gypsum board R = 0.45, Insulation R = 5.0, Concrete R = 0.64, Outside air film R = 0.17***)

(07 marks)

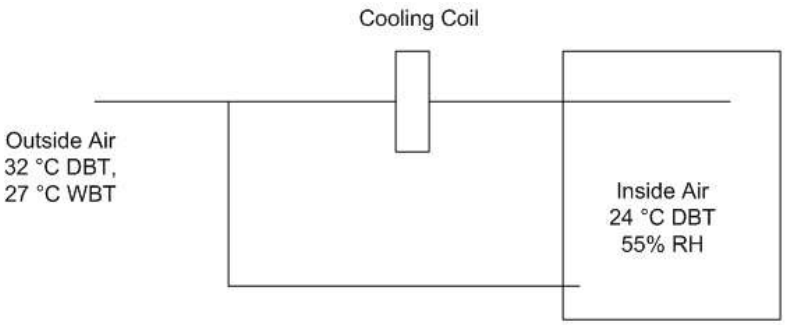


iv. The total cooling load of a walk-in cooler is 75000 Btu/hr. Determine the average hourly refrigeration load based on 20 hr per day operating time for the equipment (05 Marks)

2.

i. What are the different factors considered in load estimation sheet for comfort application? (06 Marks)

ii. The following data is given for a space to be air conditioned.



Inside design condition maintain: 24 °C DBT, 55% RH
Outside air condition: 32 °C DBT, 27 °C WBT
Room sensible heat gain (RSHG): 46.4 kW
Room latent heat gain (RLHG): 11.6 kW
Apparatus dew point temperature: 8 °C
If 25% outside air and 75% inside air is mixed and passed through the cooling coil.

a) Plot the processes on the psychrometric chart (04 Marks)

b) Calculate the Room Sensible Heat Factor (RSHF) (02 Marks)

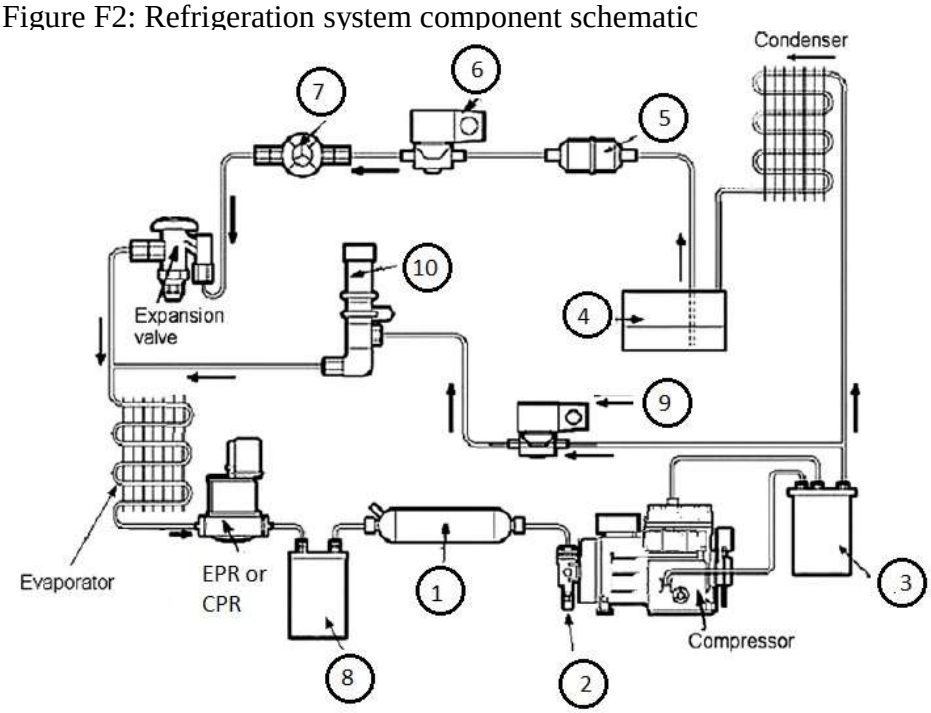
c) Determine with help of above psychrometric chart,

1. Entry conditions of air for cooling coil. (03 Marks)
2. Mass of air entering the cooler (03 Marks)

3.

i. Schematic diagram of refrigeration system components is shown in figure F2 below

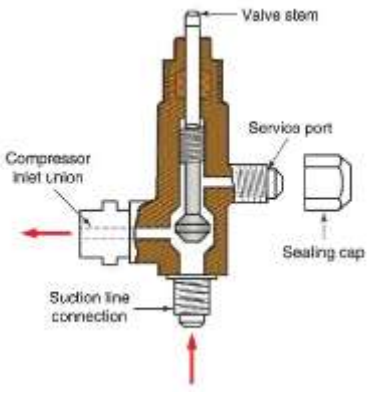
Figure F2: Refrigeration system component schematic

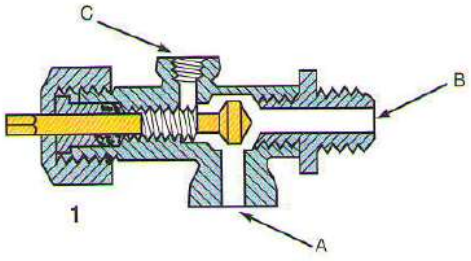


a) Name 3, 4,5,6,8 and 9 components of the system. (03 Marks)

b) Explain the function of EPR and CPR of the system (08 Marks)

c) Draw a typical service valve (sectional view) used on the compressor suction or discharge.





ii. Which lines are open/close on above valve in the following positions?

a. Front seated (01 Marks)

b. Back seated (01 Marks)

c. Middle point (01 Marks)

iii. Name two safety controls used in a refrigerant circuit to protect the refrigeration equipment. (02 Marks)

4.

i. Briefly describe the direct and indirect systems used in Refrigeration. (04 Marks)

ii. Briefly explain with the help of sketches the location and installation of sensing bulb of thermostatic expansion value. (05 Marks)

iii. Make a labeled line diagram showing the layout of a commercial refrigeration forced draft evaporator an externally equalized thermostatic expansion value. (03 Marks)

iv. Make simple line sketches showing vertical cross-sectional through and label the main components, of,

i. A water cooling tower (02 Marks)
ii. An evaporative condenser (02 Marks)

v. Prepare service and maintenance chart for a cooling tower used in low temperature applications. (04 Marks)

5.

i. Draw refrigerant flow diagram and sketch a pressure – enthalpy diagram, relevant to a cold room having three different temperature (-20°C, -5°C and 10°C) using with reciprocating compressor. This cold room have manual stop valve in the suction, and liquid lines permit isolation of the individual evaporators for maintenance. (12 Marks)

ii. How do we check the sub cooling of the system? (02 Marks)

iii. What are the reasons for low sub cooling in the system? (03 Marks)

iv. Write down the reason for Reduction in suction pressure (3 Marks)

6.

i. Automatic pump down system is vital for successful and operation of industrial refrigeration plants.

   i. State shut down sequence of automatic pump down cycle. (03 Marks)

   ii. State startup sequence of automatic pump down cycle. (03 Marks)

ii. Write the four (04) methods used for defrosting the evaporators. (02 Marks)

iii. Briefly explain the two methods that can be used for defrosting of cold room evaporator. (06 Marks)

iv. Give common cause and remedial action for the following troubles while using two door on-frost type refrigerators.

   i. Refrigerator section too warm. (02 Marks)

   ii. Freezer section too cold. (02 Marks)

   iii. Unit runs all the time. (02 Marks)

7.

i. A small cold room has the following components for a refrigeration circuit. Using correct standards symbols draw the refrigeration gas circuit. (12 Marks)

Components: -

   i. Open type – belt driven reciprocating compressor
   ii. Air cooled condenser
   iii. Evaporator with fan
   iv. Thermostatic expansion valve with internal equalizer
   v. Receiver
   vi. Filter drier
   vii. Pump down solenoid valve
   viii. Suction accumulator
   ix. Sight glass with moisture indicator
   x. Hot gas defrost solenoid

ii. Redraw a Star / Delta three phase motor power circuit with including electrical protections, using the correct electrical circuit symbols. (08 Marks)

8. Fig No F2 shows the front elevation, end elevation and the plan. Draw an Isometric drawing of the given figure (20 Marks)

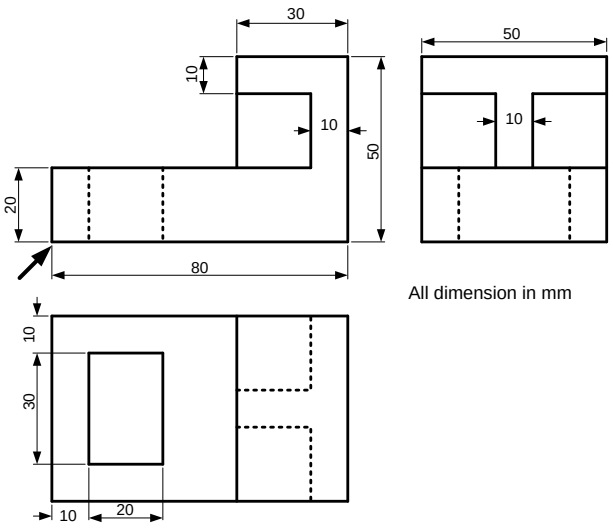


Fig. No F2

9.

i. Usually chemical produces are requested to provide information sheet regarding the characteristic of the particular chemicals (such as refrigerant). What is the name for this information sheet? (01 marks)

ii. List eight (08) major item provided in this sheet. (06 marks)

iii. Briefly explain the following definitions.

i. Refrigerant Recovery (02 Marks)

ii. Refrigerant Recycle (02 Marks)

iv. Imaging you have to attend the repair work of small chiller A/C plant having 10 Kg of R 22 refrigerant. Before repair you should recover the refrigerant. Draw typical lay out diagram or equipment arrangement to recover above R-22 refrigerant. (05 Marks)

v. According to the safety Group classification of refrigerants are indicated by alphanumeric characters. (A1, A2, A3 & B1, B2L, B2, B3)

i. What are indicated by A & B.? (02 marks)

ii. What are indicated by 1, 2 and 3? (02 marks)

10.

i. Briefly explain, what is Hazards and Risk? (04 Marks)

ii. What are the three steps for hazard management? (06 Marks)

iii. Indicate the possible hazards that you can experience when using scaffoldings and ladders. (04 Marks)

iv. Name three types of barriers and warning signs to protect workers and members of the public from possible accidents during installation of split air conditioner on 1st floor of the buildings. (06 Marks)

11.

i. List and briefly describe the four conditions that an air conditioning system may be required to control. (04 Marks)

ii. Sketch and label all elements of a single zone air handling unit and a typical duct arrangement. (06 Marks)

iii. Write down typical chilled water piping diagram for complete chilled water circuit (08 Marks)

iv. Explain VAV systems. (02 Marks)

12.

i. What are the factors that one has to keep in mind while selecting an air conditioning system? (04 Marks)

ii. Briefly describe Unitary vs. Central air conditioning systems. (06 Marks)

iii. Write down the preventive chiller check list and logging details. (Minimum 10 Nos.) (10 Marks).

13.

i. What are the different between AHUs, FCUs and their application? (06 Marks)

ii. What is the meaning of AHU filtration and explain about following mentioned type of filters (Pre, Bag & HEPA Filters)? (06 Marks)

iii. Write down Preventive maintenance checklist of AHUs (Minimum 08 Nos.) (08 Marks)

14.

i. Draw a neat labelled diagram of a AHU using for winter and summer season. (10 Marks)

ii. Explain with sketch the different between of Draw-Through & Blow-Through. (06 Marks)

iii. Draw simple diagrams for the AUH child water line with using two ways and three ways modulating control valve. (04 Marks)

15.

i. Briefly describe function of the Reciprocating Compressor with draw a P-V (Pressure – Volume) diagram. (08 Marks)

ii. What is compression ratio of the in refrigeration cycle? (03 Marks)

iii. Calculate the compression ratio of a R-32 compressor when the suction temperature is 04 °C and the condensing temperature is 50 °C. (06 Marks)

R-32 Pressure Temperature Chart.

Temperature (°C)	Pressure (bar A)
-6	6.68
-4	7.14
-2	7.62
0	8.13
2	8.66
4	9.22
6	9.81

Temperature (°C)	Pressure (bar A)
46	28.62
48	29.99
50	31.41
52	32.89
54	34.42
56	36.00
58	37.64

iv. Write down 3 Nos. precautions for reducing compression ratio (03 Marks)

16.

i. Name and draw simply four (04) different types of water-cooled condenser (06 Marks)

ii. Heat rejection process in the condenser occurs in three stages. Briefly describe with a sketch. (04 Marks)

iii. An air conditioning system of 05 TR capacities at an evaporator temperature of 4 ºC and the condenser temperature of 50 ºC. The refrigerant R 32 is subcooled by 08 ºC before entering the expansion valve and the vapor is superheated to 10 ºc before leaving the evaporator space

Determine the following:

i. Superheat reject from the condenser (total de-superheat). (02 Marks)

ii. The amount of heat reject from the liquid refrigerant in a condenser (total sub cooling). (02 Marks)

iii. Refrigerating effect per kilogram. (02 Marks)

iv. Mass flow rate of the refrigerant in kg/min. (04 Marks)

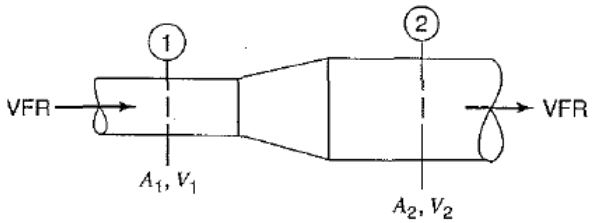
17.

i. Name three common classifications of ducts. (03 Marks)

ii. Draw simple sketches for the following rectangular duct branches. (08 Marks)

i. Elbow
ii. T-fitting
iii. Reducing-T
iv. Cross

iii. Write the basic continuity equation for air flow in ducts. (03 Marks)



iv. A square duct is to carry 21.0 m^3/min of air at a velocity of 4.0 m/s. Find duct size in mm. (06 Marks)

18. Centrifugal and Axial flow fans may be used for the transmission of air in ventilation system.

i. What are the sub classified, three types of Axial fans? (03 Marks)

ii. Draw a simple sketch to explain the function of each fans. (09 marks)

iii. Name four (04) types of following Centrifugal fans according to the shape of their impeller blades. (04 Marks)

iv. A fan is designed to supply 550m^3/min air at a static pressure of 4 mm of water gauge and fan speed 400 RPM. If the ventilation air requires an air flow of 200 m3/min. What is the new fan speed? (04 Marks)

19.

i. What are the possible data collecting techniques in a market research? (04 Marks)

ii. Briefly explain two data analysis techniques. (05 Marks)

iii. What are the techniques to be used to evaluate the performance of employees? (04 Marks)

iv. Define communication. (02 Marks)

v. Illustrate the communication process and describe each step of the process. (05 Marks)

20.

i. Below techniques can be used for information collection and analysis. Explain any two of these techniques. (10 Marks)

ii. Briefly explain below forecasting techniques (include suitable analysis tool for each method in your answer) (06 Marks)

iii. Explain continuous improvement process using PDCA cycle. (04 Marks)