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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**FRD30103**
SUBJECT TITLE	:	**SELECTION AND INSTALLATION OF RAC COMPONENTS**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**9.00 AM – 11.30 AM (2.5 HOURS)**
DATE	:	**11 JANUARY 2015**

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of TWO (2) sections. Section A and B. Answer ALL question in section A. For section B, answer TWO (2) questions only.**
6. **Answer all questions in English.**

THERE ARE 9 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (60 MARKS)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

Given are space and evaporator temperatures as stated below.

Space temperature: - 10, 35, 0, 40, 75 (^{o}F)
Evaporator temperature: - 20, 25, - 20, 20, 40 (^{o}F)

Referring to Table Q1, complete the table by following the instructions below:

(a) Choose a correct value of space and evaporator temperatures for each type of refrigeration.

(10 marks)

(b) Calculate for value of evaporator TD for each type of refrigeration.

(5 marks)

Table Q1: Design room and evaporating temperatures

TYPE OF REFRIGERATION	SPACE (ROOM) TEMPERATURE (^{o}F)	EVAPORATOR TEMPERATURE(^{o}F)	EVAPORATOR TD
Air conditioning			
Reach - in Refrigerator			
Reach-in Freezer			
Walk-in Refrigerator			
Walk-in Freezer			

Question 2

There are some aspects to be considered prior installation of air conditioning unit. The questions below help you to determine the customer requirement, type of unit to be ordered and method of installation. Answer the following questions:

(a) List down two (2) possible types of system to be selected.

(2 marks)

(b) List down three (3) possible types of an air conditioner unit to be installed.

(3 marks)

(c) List down four (4) possible orientations or positions of unit to be installed

(4 marks)

(d) Show your installation of chilled water cooling coil complete with all accessories. Sketch is required.

(6 marks)

Question 3

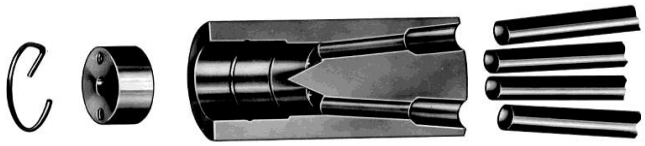

Figure Q3: A cross sectional drawing of a distributor.

(a) An example of a distributor as shown in figure Q3. Draw a distributor on an evaporator. Your sketch drawing must base on the evaporator coil characteristic which it has 3 rows, 3 circuits and 3 inlets and outlets. (Sketching and labeling for every part are required).

(10 marks)

(b) Give two (2) functions of the distributor on the evaporator.

(3 marks)

(c) How to improve the flow of refrigerant in the distributor.

(2 marks)

Question 4

Refer to Figure Q4, answer the following questions:

(a) Find a value of condenser split for each condenser coils.

(5 marks)

(b) Which condenser coil is more efficient and explain one (1) reason.

(10 marks)

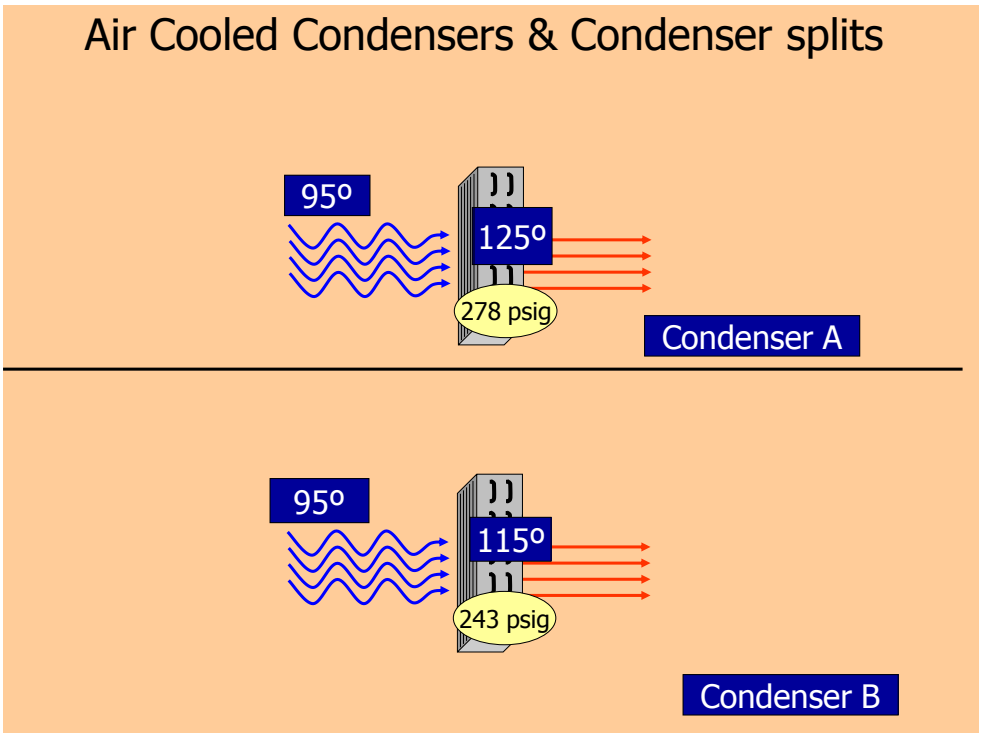

Figure Q4

SECTION B (40 MARKS)

INSTRUCTION: Answer only TWO questions
Please use the answer booklet provided.

Question 5

A cold store has a refrigeration load of 145000 Btu/h with air on to the cooler at -20ºF and evaporating R-22 at -32ºF. Four fins per inch are required. The anticipated frosting is very heavy due to a high service load; electric defrost is required. The store is 100 ft long X 40 ft wide X 20 ft high. Referring to Figure Q5.1 and Q5.2, answer the following:

(a) Find a correction factor. (5 marks)
(b) Calculate total cooling capacity. (10 marks)
(c) Select a suitable model of cooler. (5 marks)

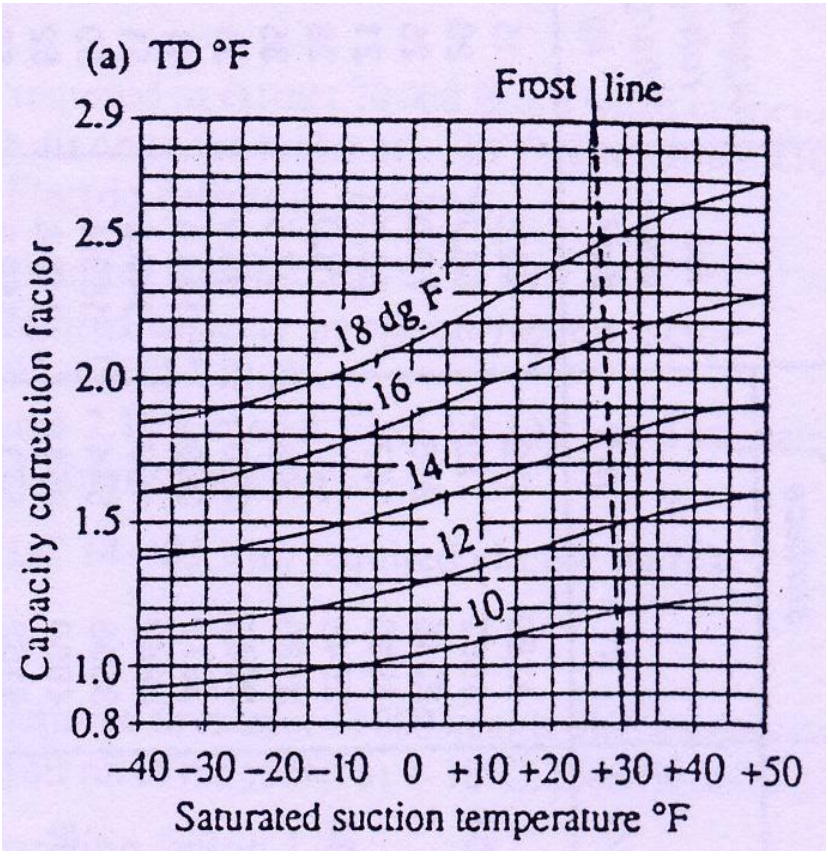

Figure Q5a: Duty capacity correction factor

Table 2.11 Capacities for floor mounted coolers, 4 fins/inch (spacing 6.4 mm) (Searle)

Model	Size	Capacity*					Nominal air volume		Coil data			
		Btu/h	kW		kcal/h				Total surface		Int. vol.	Approx. refrig. charge
		10°F TD	6°C TD	6°C TDM	6°C TD	6°C TDM	ft³/min	m³/s	ft²	m²	dm³	kg
FLC 12	64	53 300	16.87	19.25	14 500	16 600	12 800	6.04	1389	129	42.5	15
	84	64 600	20.46	24.08	17 600	20 700			1852	172	56.7	20
	104	74 600	23.62	28.06	20 300	24 100			2315	215	70.9	25
FLC 14	64	70 800	22.40	25.63	19 300	22 000	16 400	7.74	1910	177	58.5	21
	84	86 100	27.26	32.37	23 400	27 800			2546	237	78.0	28
	104	99 700	31.55	37.48	27 100	32 200			3183	296	97.5	35
FLC 16	64	107 200	33.92	38.70	29 200	33 300	24 600	11.61	2905	270	85.9	31
	84	130 700	41.36	49.76	35 600	42 800			3873	360	114.6	41
	104	154 000	48.75	58.95	41 900	50 700			4842	450	143.2	51
FLC 18	64	140 400	44.44	49.99	38 200	43 000	33 600	15.86	3698	344	109.4	39
	84	171 100	54.15	62.28	46 600	53 600			4930	458	145.8	52
	104	203 600	64.43	76.02	55 400	65 400			6162	573	182.3	66
FLC 20	64	183 300	58.02	66.58	49 900	57 200	48 000	22.65	4435	412	126.0	46
	84	223 600	70.78	84.44	60 900	72 600			5914	549	168.0	62
	104	263 600	83.43	98.61	71 700	84 800			7392	687	210.0	77
FLC 22	64	215 600	68.26	79.75	58 700	68 600	50 400	23.79	5702	530	162.0	59
	84	262 800	83.18	99.74	71 500	85 800			7603	706	216.0	79
	104	311 400	98.57	118.11	84 800	102 400			8504	883	270.0	99

Table 2.11 *(continued)*

Model	Size	Fan and motor specification										Electric defrost			Approx. dry weight† kg
		No. of fans	Diameter		rpm	Air throw		Noise level dB(A)	Motor size kW	Power input kW	380–3–50	EL1	EL1 and EL2	EL2	
			in	mm		ft	m				FLC A	SC A	Coil kW	Drain pan kW	Coil kW	
FLC 12	64	2	24	608	1440	102	31	70	1.3	1.9	3.3	12	5.0		8.0	503
	84												8.0	4.0	11.0	532
	104												11.0		14.0	561
FLC 14	64	2	24	608	1440	135	41	72	2.5	2.8	5.7	30	11.0		14.0	565
	84												14.0	4.0	17.0	604
	104												17.0		23.0	644
FLC 16	64	3	24	608	1440	135	41	74	2.5	2.8	5.7	30	16.7		21.3	825
	84												21.3	6.1	25.9	886
	104												25.8		35.0	946
FLC 18	64	2	30	762	1450	210	64	78	4.2	6.5	9.0	52	21.3		25.9	958
	84												25.8	6.1	35.0	1035
	104												35.0		48.6	1119

* TD is the temperature difference between the entering air and the saturated suction temperature at the outlet of the cooler.
TDM is the temperature difference between the mean of entering and leaving air and the saturated suction temperature at the outlet of the cooler.
† The weights stated are for units with Cu/Al coils including the Searle cowl, and can vary dependent on type of defrost.

continued

Figure Q5b: Capacities for floor mounted cooler

Question 6

Select a suitable model of a thermal static expansion valve (TXV) for the following application. Refer to information given, table Q6a and Q6b, show the formula, calculation and selection.

Refrigerant = R404A
Required valve connection = solder, angleway.
Evaporator capacity Qe = 13kW
Evaporating temperature, Te = -10^{o}C (≈ Pe = 3.6 bar)
Condensing temperature, Tc = 36^{o}C (≈ Pc = 13.9 bar)
Evaporator with six sections.
Size and length of liquid line, diameter ½ inch, Length = 25 m.
Since the evaporator is placed 12 m higher than the receiver, h = 12 m.

GIVEN:

(1) Pressure drop ∆p1 in the liquid line. For example: ∆p1≈0.1 bar
(2) The assumed pressure drop, p2, in filter drier,sight glass, manual shut-off valve and pipe bends: ∆p2 ≈ 0.2 bar.
(3) Find ∆p3, in the vertical liquid line.
(4) Pressure drop ∆p4 in the liquid distributor: ∆p4 ≈0.5 bar
(5) Pressure drop ∆p5 in the distributor tubes: ∆p5 ≈ 0.5 bar

You are asked to answer the following questions:

(a) Find pressure drop p3.

(2 marks)

(b) Total pressure drop across expansion valve

(5 marks)

(c) Calculate capacity of TXV

(8 marks)

(d) Select a suitable model of TXV.

(5 marks)

Table Q6a: Pressure drop

Refrig-erant	Static pressure drop, Δp_3 bar at height difference h between evaporator and receiver				
	6 m	12 m	18 m	24 m	30 m
R 22	0.7	1.4	2.1	2.8	3.5
R 134a	0.7	1.4	2.1	2.8	3.6
R 404A	0.6	1.3	1.9	2.5	3.2
R 507	0.6	1.3	1.9	2.5	3.2

Table Q6b: TXV selection table

Valve type	Orifice no.	Pressure drop across valve Δp bar							
		2	4	6	8	10	12	14	16
Evaporating temperature –10°C									
TX 2/TEX 2-0.15	0X	0.37	0.47	0.53	0.57	0.60	0.63	0.64	0.64
TX 2/TEX 2-0.3	00	0.79	0.96	1.1	1.2	1.2	1.3	1.3	1.3
TX 2/TEX 2-0.7	01	1.6	2.0	2.3	2.5	2.6	2.7	2.8	2.8
TX 2/TEX 2-1.0	02	2.2	2.9	3.3	3.6	3.8	4.0	4.1	4.1
TX 2/TEX 2-1.5	03	3.9	5.1	5.9	6.4	6.8	7.1	7.3	7.3
TX 2/TEX 2-2.3	04	5.8	7.6	8.7	**9.5**	**10.1**	10.5	10.8	10.9
TX 2/TEX 2-3.0	05	7.4	9.6	11.0	12.0	12.8	13.3	13.6	13.8
TX 2/TEX 2-4.5	06	9.1	11.8	13.5	14.7	15.6	16.2	16.6	16.8

Question 7

Refer to figure Q7a and Q7b. Select an Air Handling Unit model and size (length, width and height) for the following application:

(20 marks)

Given:

(1) Application = general office

(2) Cooling Capacity = 110 kW

(3) K = 25 mm casing thickness

(4) Section of equipment = High velocity filter, Mixing Box (MXB), Low velocity filter, Access panel, Coil and Fan.

(5) Equipment type = Horizontal unit.

1) External AHU Length = (Section Length + K) mm
   K = 110mm for 25mm casing thickness
   160mm for 50mm casing thickness
   210mm for 75mm casing thickness

2) External AHU Width = (Unit Width + K) mm

3) For Horizontal Unit, External AHU Height = (HH + K + 100*) mm
   For Vertical Unit, External AHU Height = (HV + 2K + 100*) mm
   *100mm is for unit base

4) If the External AHU Length is > 1900mm, section will be split into several casing for shipping purposes.

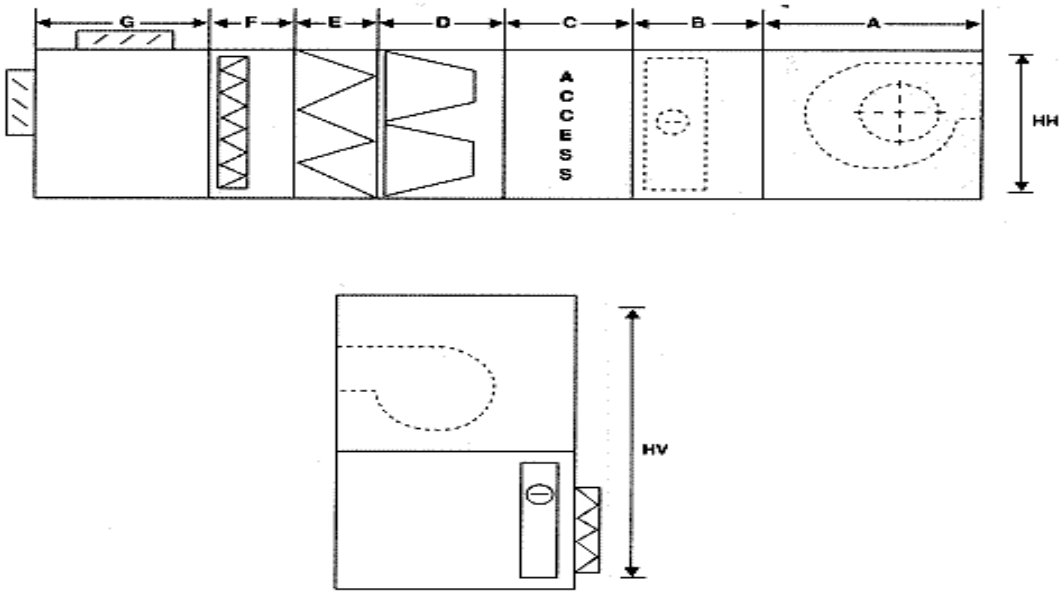

Figure Q7a: Unit configuration

Dimension

Unit Size	Fan Size	Range Of Hp	Nominal Capacity (kW)	Nominal A/Flow @ 2.5m m/s	Section Length MXB (G)	HVF (F)	Filter LVF (E)	BF (D)	Access (C)	Coil (B)	Fan (A)	Unit HH* (mm)	Unit Width (mm)	Unit HV** (mm)
0508A	FCG 02-180	1 ~ 1.5	7.8	425	600	300	600	600	600	500	500	500	800	1000
	FCG 02-180	1.5 ~ 2												
0508B	FCG 02-180	1.5 ~ 2	11.4	614	600	300	600	600	600	500	500	500	800	1000
0511	FCG 02-200	1.5 ~ 3	15.8	850	600	300	600	600	600	500	600	500	1100	1000
0612	FCG 02-225	2 ~ 4	22.9	1227	600	300	600	600	600	500	600	600	1200	1200
	BCG 12-225	3 ~ 5												
0713	FCG 02-280	3 ~ 5	32.5	1746	600	300	600	600	600	500	700	700	1300	1400
	BCG 02-280	4 ~ 7.5												
0813	FCG 02-315	4 ~ 5	37.8	2030	600	300	600	600	600	500	800	800	1300	1600
	BCG 12-315	5 ~ 7.5												
0914	FCG 02-355	4 ~ 7.5	48.8	2620	600	300	600	600	600	500	900	900	1400	1800
	BCG 12-355	5 ~ 10												
0916	FCG 02-355	4 ~ 7.5	53.6	2879	600	300	600	600	600	500	900	900	1600	1800
	BCG 12-355	7.5 ~ 15												
1018	FCG 02-400	5 ~ 10	66.8	3587	600	300	600	600	600	500	1000	1100	1800	2000
	FCG 05-450	7.5 ~ 10												2100
	BCG 15-400	7.5 ~ 15												
	BCG 15-450	10 ~ 15												
1118	FCG 05-450	7.5 ~ 15	78.2	4201	600	300	600	600	600	500	1000	1100	1800	2200
	BCG 15-450	10 ~ 15												
1319	FCG 05-450	7.5 ~ 15	96.7	5192	600	300	600	600	600	500	1000	1300	1900	2400
	BCG 15-450	10 ~ 15												
	FCG 05-500	10 ~ 20			600	300	600	600	600	500	1100			2500
	BCG 15-500	15 ~ 20												
1422	FCG 05-500	10 ~ 15	109.8	5900	900	300	600	600	600	500	1100	1400	2200	2600
	BCG 15-500	10 ~ 15												
	FCG 02-560	15 ~ 20			900	300	600	600	600	500	1200			2700
	BCG 15-560	15 ~ 20												
1522	FCG 02-560	10 ~ 20	118.6	6372	900	300	600	600	600	500	1200	1500	2200	2800
	BCG 15-560	15 ~ 20												
	FCG 02-630	15 ~ 25			900	300	600	600	600	500	1400			3000
	BCG 15-630	20 ~ 25												
1722	FCG 02-630	15 ~ 20	136.2	7316	900	300	600	600	600	500	1400	1700	2200	3200
	BCG 15-630	15 ~ 25												
	FCG 02-710	20 ~ 25			900	300	600	600	600	500	1500			3300
	BCG 15-710	20 ~ 30												
1724	FCG 02-630	15 ~ 25	153.6	8290	900	300	600	600	600	500	1400	1700	2400	3200
	BCG 15-630	15 ~ 25												
	FCG 02-710	20 ~ 30			900	300	600	600	600	500	1500			3300
	BCG 15-710	20 ~ 30												
1725	FCG 05-630	15 ~ 25	166.9	8988	900	300	600	600	600	500	1400	1700	2500	3200
	BCG 15-630	15 ~ 25												
	FCG 02-710	20 ~ 30			900	300	600	600	600	500	1500			3300
	BCG 15-710	25 ~ 40												
1926	FCG 02-710	15 ~ 25	184.5	9912	1300	300	600	600	600	500	1500	1900	2600	3500
	BCG 15-710	20 ~ 30												
	FCG 05-800	25 ~ 40			1300	300	600	600	600	500	1700			3700
	BCG 15-800	25 ~ 40												
2127	FCG 05-710	15 ~ 25	215.3	11584	1300	300	600	600	600	500	1500	2100	2700	3700
	BCG 15-710	20 ~ 30												
	FCG 05-800/GI	25 ~ 40			1300	300	600	600	600	500	1700			3900
	BCG 15-800/GI	30 ~ 50												
2230	FCG 05-800	20 ~ 30	254.8	13688	1300	300	600	600	600	500	1700	2200	3000	4000
	BCG 15-800	20 ~ 30												
	FCG 05-900	30 ~ 50			1300	300	600	600	600	500	1900			4200
	BCG 15-900	40 ~ 50												
2234	FCG 05-800/GI	20 ~ 40	298.7	16048	1300	300	600	600	600	500	1700	2200	3400	4000
	BCG 15-800/GI	20 ~ 40												
	FCG 05-900/GI	30 ~ 60			1300	300	600	600	600	500	1900			4200
	BCG 15-900/GI	40 ~ 60												
2434	FCG 05-900	25 ~ 40	325.1	17464	1300	300	600	600	600	500	1900	2400	3400	4400
	BCG 15-900	25 ~ 40												
	FCG 05-1000	40 ~ 60			1300	300	600	600	600	500	2000			4500
	BCG 15-1000	40 ~ 60												
2636	FCG 05-900/GI	25 ~ 50	377.8	20296	1300	300	600	600	600	500	1900	2600	3600	4600
	BCG 15-900/GI	25 ~ 50												
	FCG 05-1000	40 ~ 75			1300	300	600	600	600	500	2000			4700
	BCG 15-1000	40 ~ 75												

*HH - Height Horizontal **HV - Height Vertical

Figure Q7b: Dimension of units

END OF QUESTION