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SET B

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2010 SESSION

SUBJECT CODE	:	**FRD 30103**
SUBJECT TITLE	:	**SELECTION AND INSTALLATION OF RAC COMPONENTS**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**8.00pm – 11.00pm (3 HOURS)**
DATE	:	**27 APRIL 2010**

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

a. The HVAC industry had been historically regulated by the manufacturers of HVAC equipment, but Regulating and Standards organizations such as in the list below have been established to support the industry and encourage high standards and achievement. Give the full name for the following abbreviations:

(5 marks)

i) ASHRAE
ii) SMACNA
iii) ARI
iv) AMCA
v) IIR

b. Give a function of the following systems:

i) Air conditioning system (5 marks)

ii) Ventilation system (5 marks)

Question 2

a) Give five types of piping connection and its application in air conditioning installation. Sketching is required to show the type of connection.

(10 marks)

b) What is method of statement and give three reasons why it is required to prepare a method of statement for a new installation.

(10 marks)

Question 3

Prepare a method statement to install Air Handling Unit (AHU) at level 3 of a building. AHU type: Top discharge air, right hand side piping connection. AHU size 3300 mm length, 1300 mm width and 900 mm height. You should propose an AHU room size, concrete plinth size and AHU arrangement inside the room.

(15 marks)

Question 4

a) Explain in detail the function and working principle of thermostatic expansion valve (TXV) in refrigeration system. State the formula for sub cool and superheat.

(5 marks)

b) Explain briefly the importance of performance data of a product from manufacturer.

(5 marks)

SECTION B

INSTRUCTION: Answer only TWO questions

Please use the answer booklet provided.

Question 5

Select a suitable model of a thermostatic expansion valve (TXV) for the following application. Referring to information given in table1 and 2, show the formula, calculation and selection of TXV.

Refrigerant = R22
Required valve connection = solder, angleway.
Evaporator capacity Qe = 9kW
Evaporating temperature, Te = -10°C (≈ Pe = 3.6 bar)
Condensing temperature, Tc = 36°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 6 m higher than the receiver, h = 6 m.

GIVEN:

1) Pressure drop $\Delta p1$ in the liquid line. For example: $\Delta p1 \approx 0.1$ bar
2) The assumed pressure drop, p2, in filter drier,sight glass, manual shut-off valve and pipe bends: $\Delta p2 \approx 0.2$ bar.
3) Find $\Delta p3$, in the vertical liquid line.
4) Pressure drop $\Delta p4$ in the liquid distributor: $\Delta p4 \approx 0.5$ bar
5) Pressure drop $\Delta p5$ in the distributor tubes: $\Delta p5 \approx 0.5$ 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 1: 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 2: 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 6

Referring to attachment 1, 2 and 3, select a suitable model of an evaporator for the given application:

Given:

Required capacity	Q	= 28000 W
Air inlet temperature	tA1	= +2 °C
Evaporating temperature	te	= - 8 °C
Refrigerant		= R22

Coil with coated fin

You are asked to find:

a) DT1 (1 marks)

b) Wet coil factor (1 marks)

c) Correction for temperature difference (1 marks)

d) Refrigerant factor (1 marks)

e) Fin material factor (1 marks)

f) Calculate required capacity (10 marks)

Question 7

Refer to figure 1 and 2. Select an Air Handling Unit model and size (length, width and height) for the following application: (20 marks)

Given:

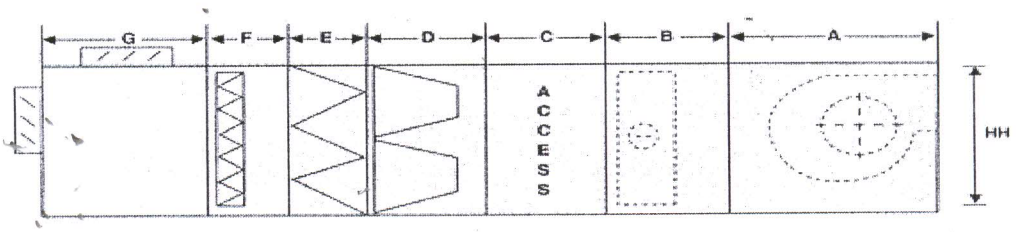
1) Application = general office
2) Cooling Capacity = 32 kW
3) K = 25 mm casing thickness
4) Section of equipment = High velocity filter, Low velocity filter, Access panel, Coil and Fan.
5) Equipment type = Horizontal unit.

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.



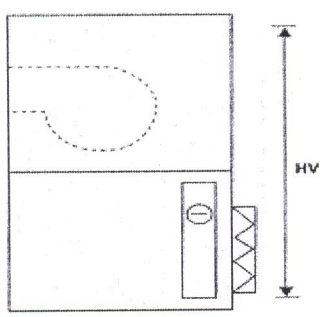


Figure 1: Unit configuration

END OF QUESTION

Dimension

Unit Size	Fan Size	Range Of Hp	Nominal Capacity (kW)	Nominal A/Flow @2.5m m/s	Section Length							Unit HH* (mm)	Unit Width (mm)	Unit HV** (mm)
					MXB (G)	Filter HVF (F)	Filter LVF (E)	Filter BF (D)	Access (C)	Coil (B)	Fan (A)			
0508A	FCG 02-160	1 ~ 1.5	7.9	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	800	500	1100	1000
0612	FCG 02-225	2 ~ 4	22.8	1227	600	300	600	600	600	500	600	600	1200	1200
	BCG 12-225	3 ~ 5												
0713	FCG 02-280	3 ~ 5	32.5	1748	600	300	600	600	600	500	700	700	1300	1400
	BCG 02-280	4 ~ 7.5												
0813	FCG 02-315	4 ~ 5	37.9	2038	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	2626	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			2600
	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	8280	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	3600
	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	299.7	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			4600
	BCG 15-1000	40 ~ 60												
2636	FCG 05-900/GI	25 ~ 50	387.8	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 2: Dimension of units

BRB range unit coolers are suitable for chilling or low temperature storage applications. 24 basic models with capacities ranging from 4 to 30,5 kW.

The **BRB** unit cooler line is **EUROVENT** approved. The ratings indicated are certified compliant to European standard **EN 328**.
www.eurovent-certification.com

RVK Peripheral heaters
ELK Full electrical defrosting (5 coil heaters + 1 drain pan heater)
E1K Light electrical defrosting for BRB F8 and BRB S8 (3 coil heaters)
Reinforced electrical defrosting for BRB E7 and BRB D7 (3 additional heaters in the coil)
THD Defrost control thermostat (5709L)
THS Safety thermostat (5708L)
2TH Defrost control and safety thermostat (5709L + 5708L)

BYP Polual Blygold coating of the fins
BAE Coating of the fins (except 4 fan units)
WCO Glycol water and brine
DCF Dual circuit hot/cold

RVD Peripheral heaters
HG1 Hot gas (coil: hot gas, drain pan: electrical heaters)
HGT Hot gas (coil and drain pan)

RCS Electrical heaters on air discharge
VGT Flange of textile duct with guard for aerofoil fan

HFA Streamer
2VF 2 speed 400 V 50 Hz fan assembly
MMS Single phase 230 V 50 Hz fan assembly
MP5 400 V 50 Hz aerofoil fan
M60 230/400 V 60 Hz three phase fan assembly
CMU* Factory wiring
*CMU = CT5, CT6, CM5 or CM6
CT5 Factory wiring 1 speed 50 Hz
CT6 Factory wiring 1 speed 60 Hz
CM5 Factory wiring 1 speed 230V/1/50 Hz
CM6 Factory wiring 1 speed 230V/1/60 Hz

EDL Expansion valve provided.

EEC Fully equipped unit cooler.

The highly efficient and compact BRB range finned coils are designed with corrugated surface aluminium fins (fin spacing 4.23 or 6.35 mm) and grooved internal structure copper tubes.
The refrigerant distributors are nozzle type (nozzle factory fitted).

An aesthetic white enamelled galvanized steel sheet casing allows for easy cleaning of the unit.
BRB...E7 and BRB...D7 are equipped with an internal drain pan which limits condensation.
The easily removable side panels and the hinged external drain pan allow for easy access to the components of the evaporator (coil, fan assemblies, heater elements, connections...).
The hinging system allows the drain pan to be taken off.

The tubular electric heaters are fitted into pipes expanded in the finned block. One of these heaters is fixed under the intermediate drain pan, thus insuring equal heat distribution for a quick and efficient defrost.
The heaters are factory wired to a terminal block and coupled 400V 3 phase.
Possibility of coupling 230 V 3 phase or 230 V 1 phase.
Defrost water is collected in the intermediate drain pan then drained through a large drain fitting (Ø 1" G).

The BRB unit cooler line is equipped with propeller type fan assemblies, Ø 450 mm, 4 P = 1500 r.p.m., 230-400V, 3 phase, 50 Hz, IP 54, class F, requiring no routine maintenance, with built-in thermal-overload protection **which must be connected externally to effect warranty.**
The high-output, profiled blades operate at a very low noise level.
The fan guards conform to NF E51 190 standard.

ATTACHMENT 1: QUESTION 6

TECHNICAL DATA

Models			BRB .. F8	76	132	158	199	235	305
Nominal capacity	SC 2 (1) Q_{0m}		kW	7,62	13,17	15,77	19,87	23,51	30,48
Surface			m^2	28,5	38	57	57	86	105
Circuit volume			dm^3	4,85	6,57	9,69	9,58	14,36	17,48
Air flow			m^3/h	3800	8200	7600	12300	11400	14800
Fan 400 V/3/50 Hz 1500 r.p.m.	Air throw		m	16	18	18	20	20	22
	Ø 450 mm		No	1	2	2	3	3	4
	400V/3/50Hz		W max A max (2)	1 x 540 1 x 1	2 x 540 2 x 1	2 x 540 2 x 1	3 x 540 3 x 1	3 x 540 3 x 1	4 x 540 4 x 1
Electric defrost 400 V/3	ELK (3)	Total	W A	2100 3,19	3000 4,56	4200 6,38	4200 6,38	6000 9,12	7200 10,94
	E1K (3)	Total	W A	1050 1,56	1500 2,28	2100 3,19	2100 3,19	3000 4,56	3600 5,47
Net weight			kg	54	92	102	118	135	152

(1) See pages "APPENDIX"
(2) Setting of overload protections.
For room temperatures 'ti' other than +20 °C, multiply the given amperage by the ratio 293/(273 + 'ti') so as to obtain the approximate amperage after the room pull down.
(3) Electric defrost option.

(●) kit, (○) option

	RVK	ELK	E1K	THD	THS	2TH	BYP	BAE	WCO	DCF	FFP	RVU
BRB ... F8	●	●	●	●	●	●	○	○	○	○	○	○
	HG1	HGT	RCS	VGT	2V5	MM5	MP5	M60	CMU	CT5	C50	EDL	EEC
BRB ... F8	○	-	○	○	○	○	○	○	○	○	○	●	○

TECHNICAL DATA

Models			BRB .. S8	66	104	134	155	201	259
Nominal capacity	SC 2 (1) Q_{0m}		kW	6,56	10,42	13,43	15,54	20,14	25,92
Glycol water*	SC 2 (1) Q_{0m}		kW	-	-	13,04	-	17,07	26,21
Surface			m^2	19,5	26	39	39	60	73
Circuit volume			dm^3	4,85	6,57	9,69	9,58	14,36	17,48
Air flow			m^3/h	4000	8600	8000	12900	12000	15600
Fan 400 V/3/50 Hz 1500 r.p.m.	Air throw		m	16	18	18	20	20	22
	Ø 450 mm		No	1	2	2	3	3	4
	400V/3/50Hz		W max A max (2)	1 x 540 1 x 1	2 x 540 2 x 1	2 x 540 2 x 1	3 x 540 3 x 1	3 x 540 3 x 1	4 x 540 4 x 1
Electric defrost 400 V/3	ELK (3)	Total	W A	2100 3,19	3000 4,56	4200 6,38	4200 6,38	6000 9,12	7200 10,94
	E1K (3)	Total	W A	1050 1,56	1500 2,28	2100 3,19	2100 3,19	3000 4,56	3600 5,47
Net weight			kg	53	92	102	118	135	152

* Glycol water = 30% - Fluid inlet temp. = -8°C - Fluid outlet temp. = -4°C - Dry air = +2°C - RH = 85%
(1) See pages "APPENDIX"
(2) Setting of overload protections.
For room temperatures 'ti' other than +20°C, multiply the given amperage by the ratio 293/(273 + 'ti') so as to obtain the approximate amperage after the room pull down.
(3) Electric defrost option.

(●) kit, (○) option

	RVK	ELK	E1K	THD	THS	2TH	BYP	BAE	WCO	DCF	FFP	RVU
BRB ... S8	●	●	●	●	●	●	○	○	○	○	○	○
	HG1	HGT	RCS	VGT	2V5	MM5	MP5	M60	CMU	CT5	C50	EDL	EEC
BRB ... S8	○	-	○	○	○	○	○	○	○	○	○	●	○

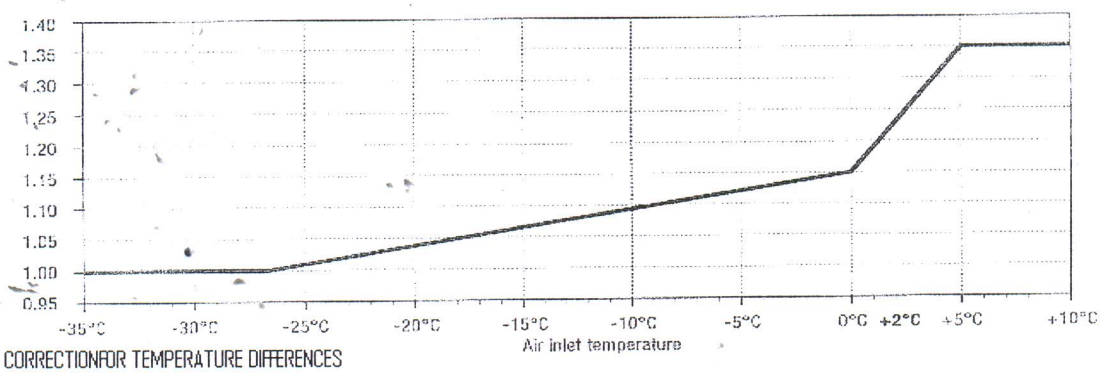
ATTACHMENT 2: QUESTION 6

STANDARD CONDITIONS

Standard conditions	tA1 Air inlet temperature	te Evaporating temperature	Standard DT1
SC 1	+10 °C	0 °C	10
SC 2	0 °C	-8 °C	8
SC 3	-18 °C	-25 °C	7
SC 4	-25 °C	-31 °C	6

WET COIL FACTOR

Standard conditions	Relative humidity %	Nominal capacity / Standard capacity
SC 1	85	1.35
SC 2	85	1.15
SC 3	95	1.05
SC 4	95	1.01



CORRECTIONFOR TEMPERATURE DIFFERENCES

For refrigerant with low (below 1K), or no glide, the capacity shall be assumed to vary directly with the temperature difference between the entering air and dew point evaporatoring temperature i.e:

Required capacity = Nominal capacity wet x Required DT1/Standard DT1.

REFRIGERANT FACTOR

Refrigerant	R 404A/R 507	R 22	R 134a
SC 1	1	0.95	0.93
SC 2	1	0.95	0.91
SC 3	1	0.95	0.85
SC 4	1	0.95	

FIN MATERIAL FACTOR

Aluminium fin	Coated aluminium fin	Copper fin
1	0.97	1.03

ATTACHMENT 3: QUESTION 6