CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**FRB10603**
SUBJECT TITLE	:	**APPLIED REFRIGERATION AND COMPONENTS**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**2.00 PM – 4.30 PM (2.5 HOURS)**
DATE	:	**30 DECEMBER 2014**

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 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

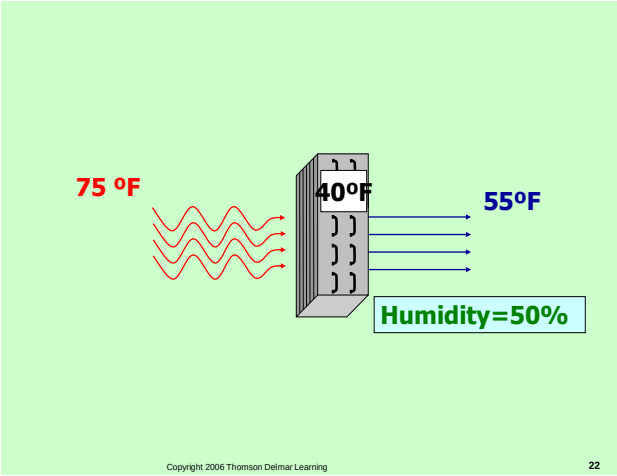
SECTION A (60 MARKS)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

Figure Q1: Typical A/C Evaporator



(a) Referring Figure Q1, answer the following questions:

i. Find the temperature difference, TD.

(4 marks)

ii. Find ΔT.

(4 marks)

iii. What happen to the humidity if we lower the TD?.

(2 marks)

(b) Give full name of the abbreviation as the following:

i) ASHARE
ii) SMACNA
iii) JIS
iv) AMCA
v) IIR

(5 marks)

Question 2

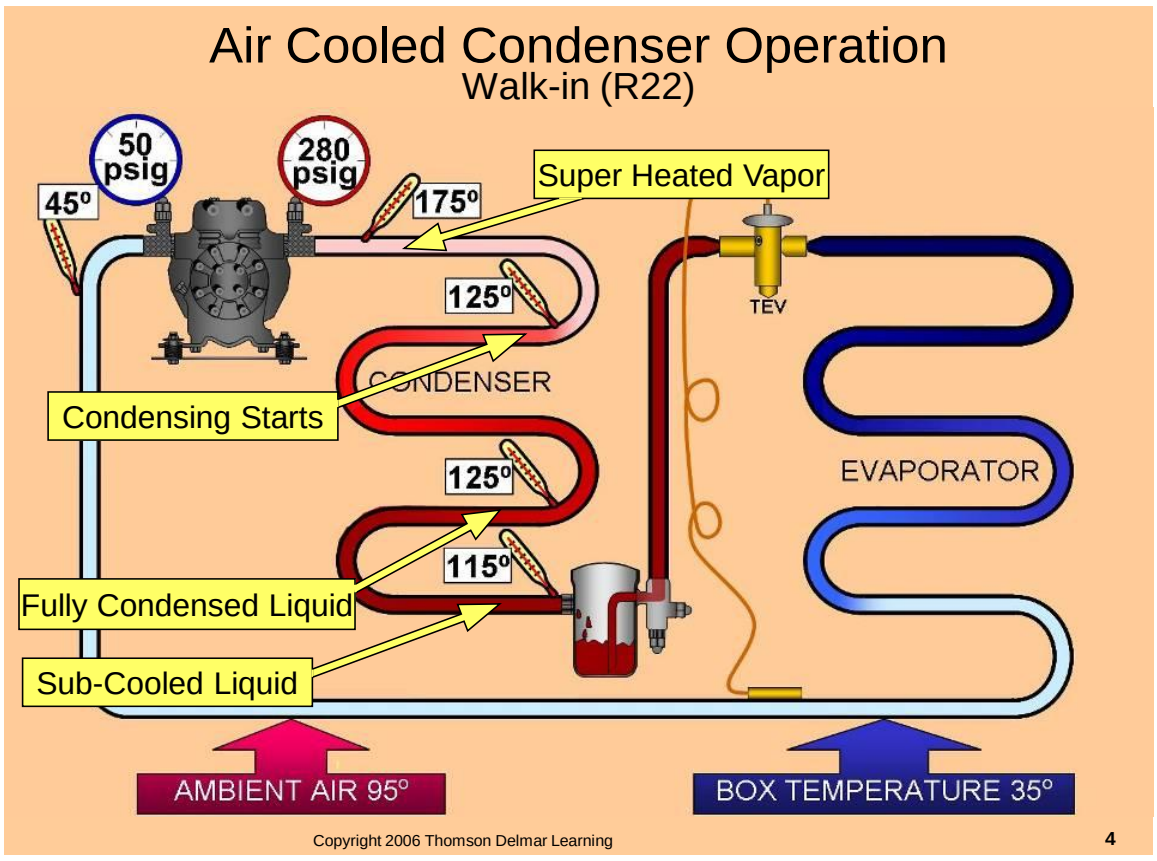
Refer to Figure Q2 below, answer the following:

a) Explain how a condenser operates. (8 marks)

b) Find condensing temperature and condenser split (4 marks)

c) Define formula and find sub cooling (3 marks)

Figure Q2: Air cooled condenser operation (reproduced with permission) Temperature ^{o}F



Question 3

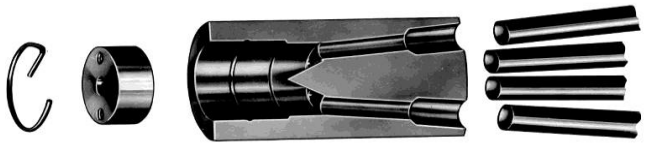


Figure Q3: A cross sectional drawing of a distributor.

(a) An example of a distributor is shown in figure Q3. Sketch a distributor connected to an evaporator coil. Your sketch drawing must base on the evaporator coil that has 4 rows, 4 circuits and 4 inlet and outlet. (Sketching and labeling for every part are required).

(10 marks)

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

(3 marks)

(c) Describe how you can improve the flow of refrigerant in the distributor?

(2 marks)

Question 4

(a) Explain in detail the function and working principles of thermostatic expansion valve (TXV) in a refrigeration system. State the formula for suction and discharge superheat.

(10 marks)

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

(5 marks)

SECTION B (40 MARKS)

INSTRUCTION: Answer only TWO questions

Please use the answer booklet provided.

Question 5

a) In countries where there is frequent rainfall, what range of temperature is regarded as Low ambient air temperature entering condenser?

(2 marks)

b) What is the significance of low ambient on the HVAC system?

(2 marks)

c) Name two methods of controlling pressure head during low ambient.

(6 marks)

d) Explain one of the methods in (c).

(10 marks)

Question 6

Refer to Figure Q6, explain the major differences between the four pictures (sections) in term of type of refrigerant, TD value, room temperature and pressure.

(20 marks)

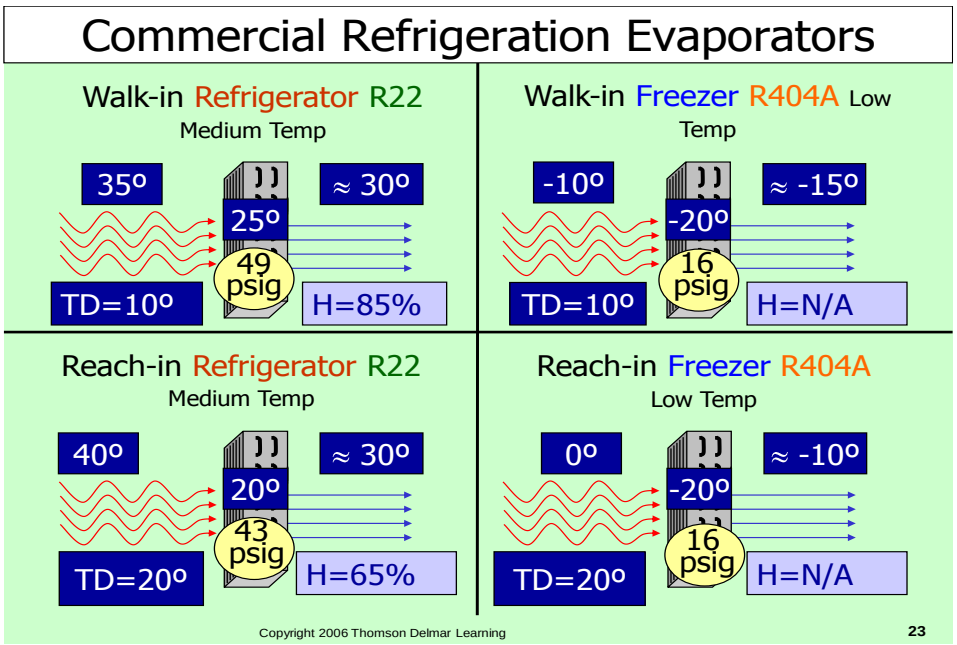


Figure Q6: Commercial refrigeration Evaporator (Temperature ^{o}F)

Question 7

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

Given:

Required capacity	Q	= 28000 W
Air inlet temperature	tA_1	= +2 ^oC
Evaporating temperature	t_e	= - 8 ^oC
Refrigerant		= R22
Coil with coated fin		

You are asked to find:

a) DT1 (1 mark)

b) Wet coil factor (1 mark)

c) Correction factor for temperature difference (1 mark)

d) Refrigerant factor (1 mark)

e) Fin material factor (1 mark)

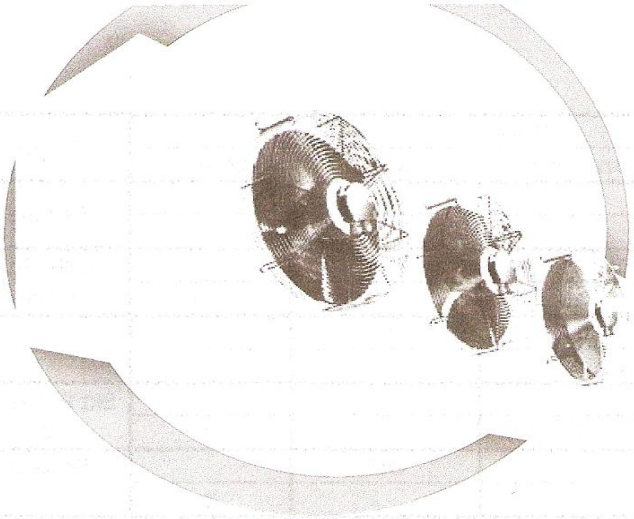
f) Calculate required capacity (10 marks)

g) Select an appropriate evaporator model (5 marks)

END OF QUESTION

APPENDIX

APPENDIX 1



BRB

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.

EUROVENT CERTIFICATION

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

Optional features

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)
	Renforced 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

RVU	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

RFA	Streamer
2V5	2 speed 400 V 50 Hz fan assembly
MM5	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.

Description

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).

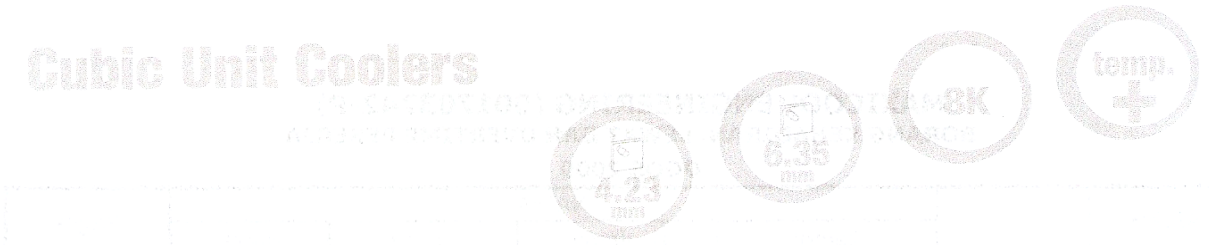
An aesthetic white enamelled galvanized steel sheet casing allows for easy cleaning of the unit.
BRB...E7 and BRB...D7 are equipped with an internal drain pan which limits condensation.
The easily removable side panels and the hinged external drain pan allow for easy access to the components of the evaporator (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.

HK REFRIGERATION

APPENDIX 2



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.

KITS & OPTIONS

(●) 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.

KITS & OPTIONS

(●) 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	○	-	○	○	○	○	○	○	○	○	○	●	○

APPENDIX 3

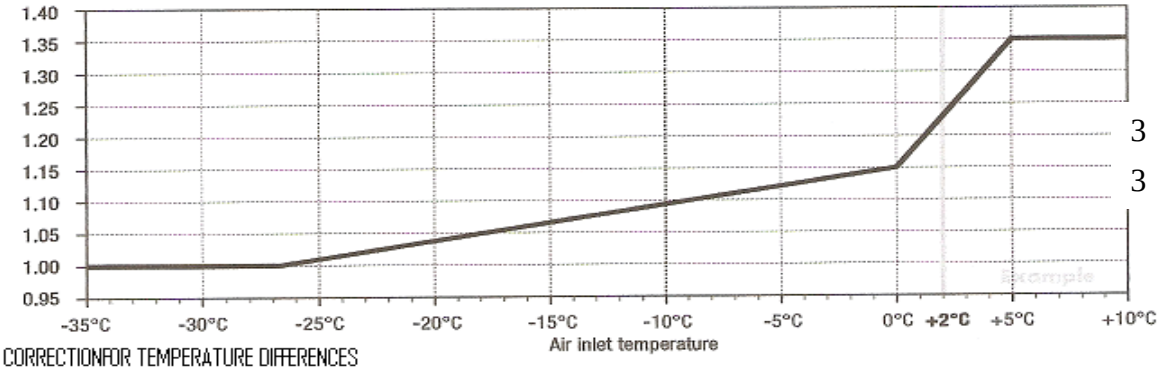
Unit coolers appendix

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 evaroratoring 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