



UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2010 SESSION

SUBJECT CODE	: FRD 20203/ FRD 20202
SUBJECT TITLE	: REFRIGERANT AND WATER TREATMENT/APPLIED CHEMISTRY
LEVEL	: DIPLOMA
TIME / DURATION	: 9.00am – 11.00am (2 HOURS)
DATE	: 07 MAY 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 questions paper consists of TWO (2) sections. Section A and B. Answer ALL questions in section A. For sections B, answer ONE (1) question only.
 6. Answer all questions in English.
 7. *Periodic Table is appended.*
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THERE ARE 4 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)**INSTRUCTION: Answer ALL questions.****Please use the answer booklet provided.****Question 1**

- a) Define what the meaning of 'refrigerant'.

(5 marks)

- b) List 5 good properties of refrigerant

(5 marks)

Question 2

Fill in the blanks below, show the details calculation for the Molecular Mass:

(NOTE: rewrite the table in the answer sheet)

(15 marks)

Table1: Refrigerant characteristics

Refrigerant Number	Chemical Name	Chemical Formula	Molecular Mass	ODP	GWP	Safety Group	Refrigerant Group
R32	Difluoromethane (methylene fluoride)	CH ₂ F ₂					
R12	Dichlorodifluoromethane	CCl ₂ F ₂					
R134a	1,1,1,2-tetrafluoroethane	CH ₂ FCF ₃					
R125	Pentafluoroethane	CHF ₂ CF ₃					
R407C	R32/125/134a (23.0/25.0/52.0)	-					

Question 3

- a) Explain what the Kyoto Protocol is about

(5 marks)

- b) Explain what is:

i. an inhibitor

(5 marks)

ii. a scale

(5 marks)

- c) List 5 negative effects of ozone depletion.

(5 marks)

Question 4

a) Referring to figure Q4, explain the R22 charging process

(10 marks)

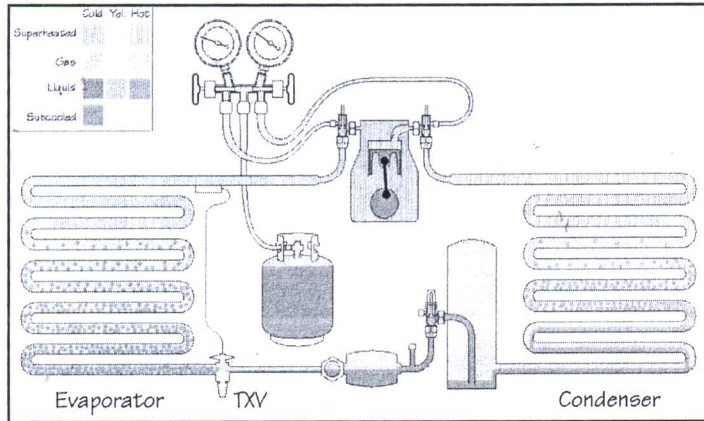


Figure Q4: Charging process

b) From your analysis of a), can the tank be put in an upside down position during the charging process? Why?

(10 marks)

c) Refer to figure Q4(a), explain the effect of overcharged

(5 marks)

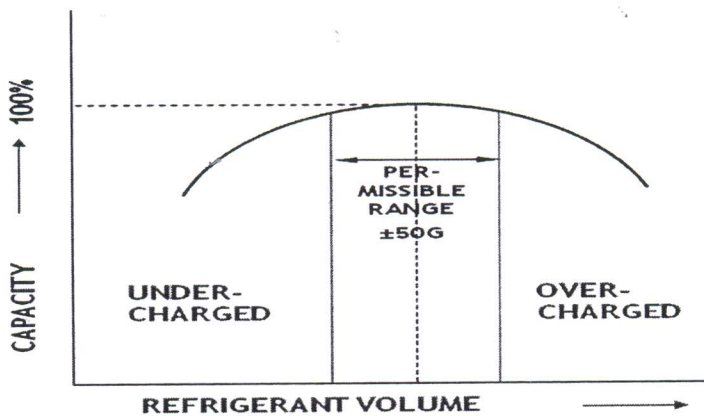


Figure Q4(a): Refrigerant capacity vs. refrigerant volume

SECTION B (Total: 40 marks)**INSTRUCTION: Answer ONE (1) question only****Question 5**

Refer to Appendix and Table attached.

Given:

A once-thru condenser:

Methyl orange alkalinity = 80 ppm as CaCO_3 Calcium hardness = 85 ppm as CaCO_3

Total solids = 250 ppm

pH = 7.5

Condensing water temperature = 110°F

Find:

- a) Langelier Saturation Index (I_s) (10 marks)
- b) Scaling tendency (10 marks)
- c) Ryznar Stability Index (10 marks)

Question 6

Given:

Mechanical draft cooling tower:

Refrigeration-load = 100 tons

Heat Rejection factor = 1.25

Condensing temperature rise = 10 degrees

Make-up water methy orange alkalinity = 40 ppm as CaCO_3 Methy orange alkalinity in recirculating water not to exceed 170 ppm as CaCO_3

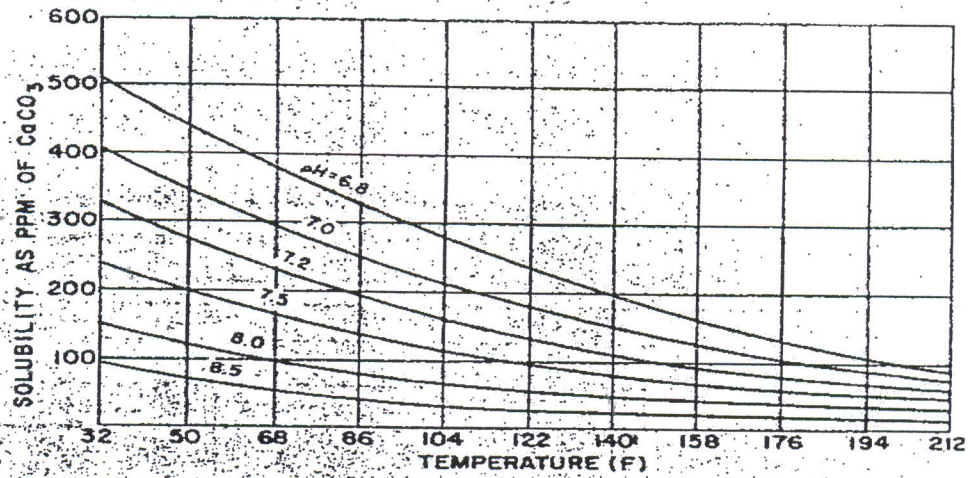
Find:

- a) Cycle concentration (6 marks)
- b) Re-circulated water quantity (gpm) (6 marks)
- c) Evaporation loss (gpm) (6 marks)
- d) Bleed-off requirement (gpm) (6 marks)
- e) Make-up water (gpm) (6 marks)

END OF QUESTION

TECHNICAL DOCUMENTS

- **FRD 20203 REFRIGERANT AND WATER TREATMENT**
- **FRD 20202 APPLIED CHEMISTRY**



NOTE: pH values at approximately 73 F.

Chart 1: Solubility as ppm CaCO₃ vs. Temperature (°F)

Table 1: Prediction of Water Characteristics by Langelier Saturation Index

LANGELIER SATURATION INDEX	TENDENCY OF WATER
+2.0	scale-forming, and for practical purposes noncorrosive
+0.5	slightly corrosive and scale-forming
0.0	balanced, but pitting corrosion possible
-0.5	slightly corrosive and nonscale-forming
-2.0	serious corrosion

Table 2: Prediction of Water Characteristics by Ryznar Saturation Index

RYZNAR STABILITY INDEX	TENDENCY OF WATER
4.0 - 5.0	heavy scale
5.0 - 6.0	light scale
6.0 - 7.0	little scale or corrosion
7.0 - 7.5	corrosion significant
7.5 - 9.0	heavy corrosion
9.0 and higher	corrosion intolerable

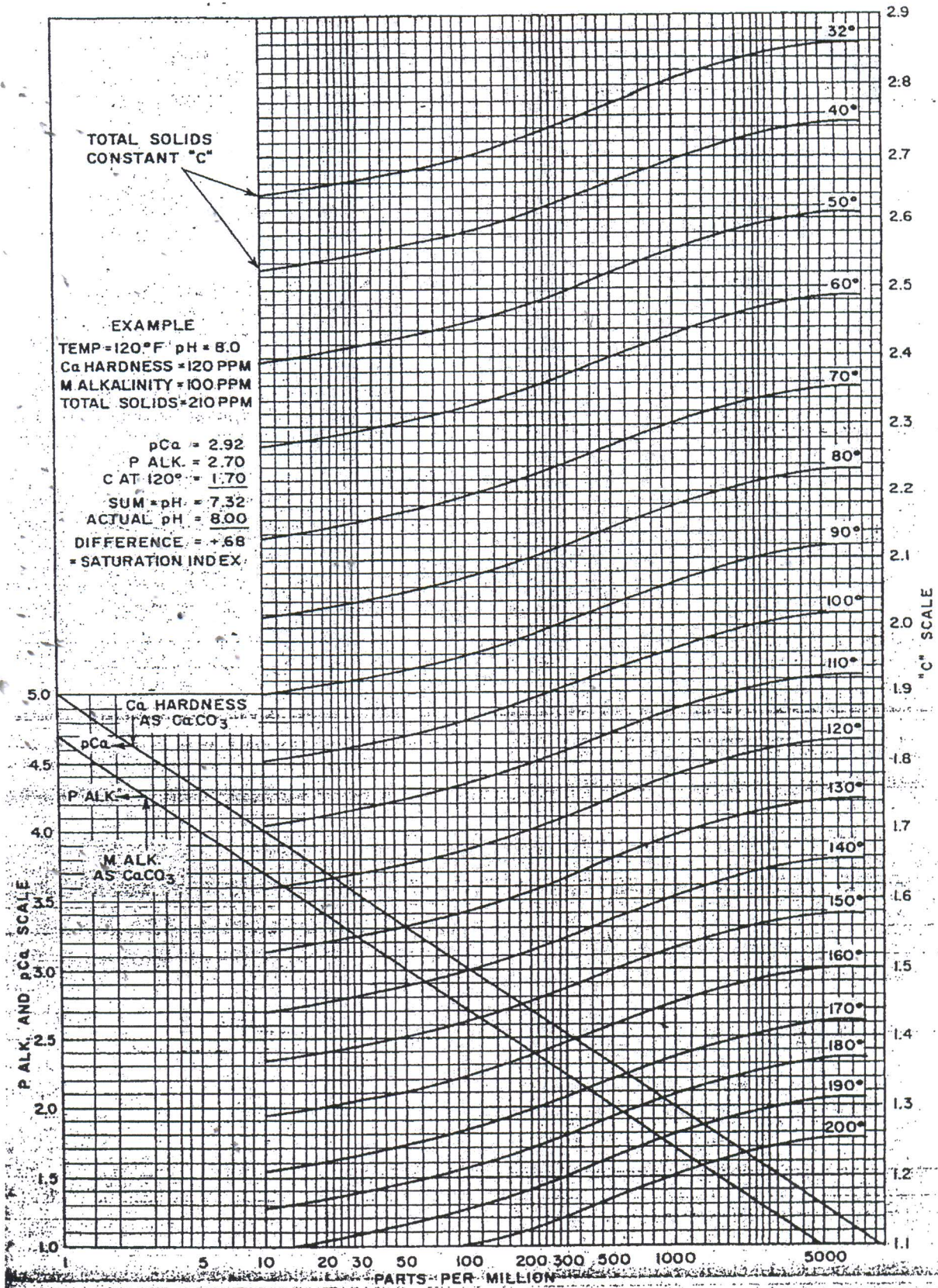


Chart 2: Langlier Saturation Index

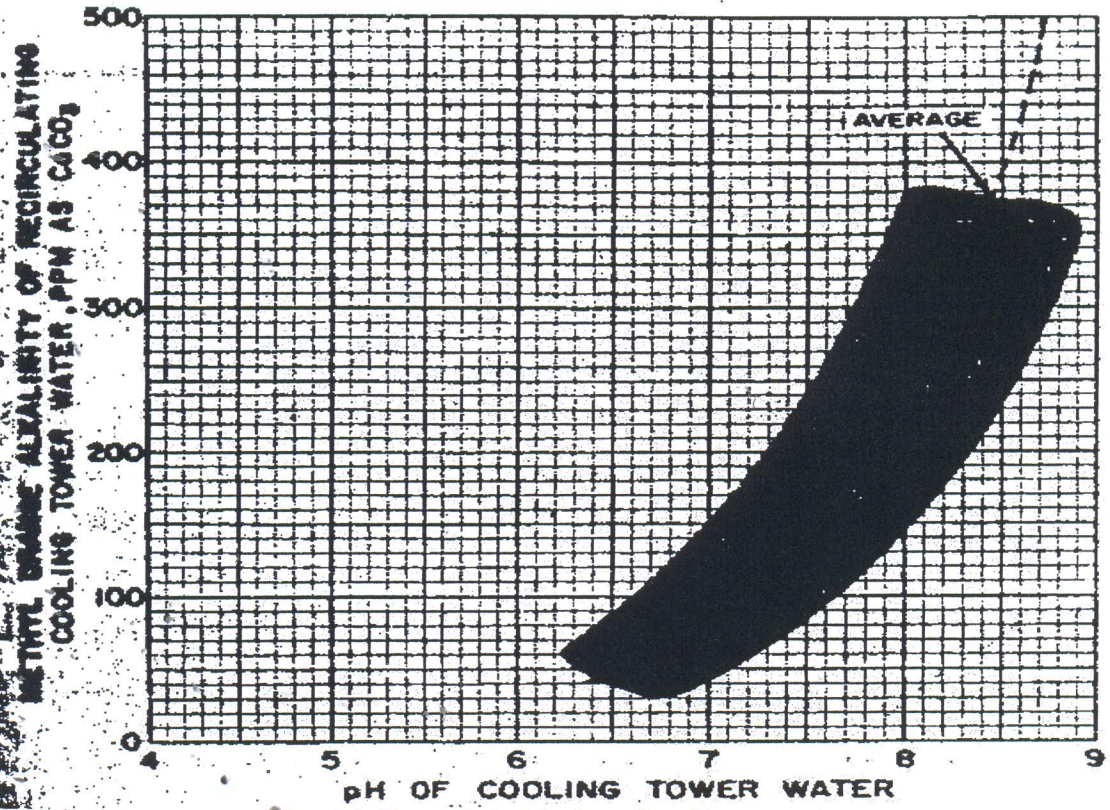


Chart 4: Expected pH of cooling Tower water

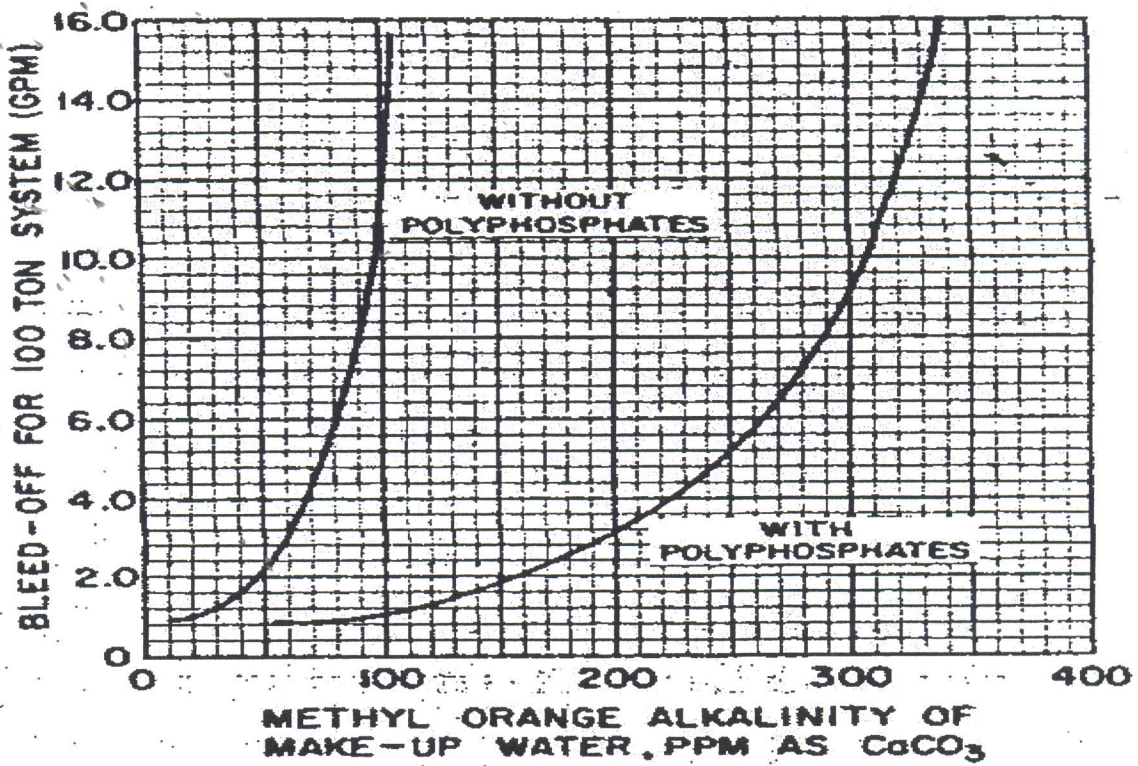


Chart 4: Bleed-off Required to prevent scale formation (100 Ton system)