



**UNIVERSITI KUALA LUMPUR**  
**Malaysia France Institute**

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**FINAL EXAMINATION**  
**JULY 2010 SESSION**

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SUBJECT CODE : <sup>R</sup> F~~A~~D 20203  
SUBJECT TITLE : REFRIGERANTS AND WATER TREATMENT  
LEVEL : DIPLOMA  
TIME / DURATION : 12.30pm – 2.30pm  
( 2 HOURS )  
DATE : 15 NOVEMBER 2010

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**INSTRUCTIONS TO CANDIDATES**

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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 questions in Section A. For Section 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.

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

(a) Define what is a refrigerant

(5 marks)

(b) List five (5) good properties of refrigerant

(5 marks)

**Question 2**

Fill in the blanks Table Q2 below, show the details calculation for the Molecular Mass:

**(NOTE: rewrite the below table and your answers in the answer sheet)**

(15 marks)

Table Q2: Refrigerant characteristics

Refrigerant Number	Chemical Name	Chemical Formula	Molecular Mass	ODP	GWP	Safety Group	Refrigerant Group
R32	Difluoromethane (methylene fluoride)	CH <sub>2</sub> F <sub>2</sub>				A2	HFC
R12	Dichlorodifluoromethane	CCl <sub>2</sub> F <sub>2</sub>					
	Chlorodifluoromethane	CHClF <sub>2</sub>					
R134a	1,1,1,2-tetrafluoroethane	CH <sub>2</sub> FCF <sub>3</sub>					
R407C	R-32/125/134a (23.0/25.0/52.0)	-					
R744		-					

**Question 3**

- (a) Explain what is:
- i. Kyoto Protocol
  - ii. Montreal Protocol.
- (10 marks)
- (b) Explain what is:
- i. Inhibitor
  - ii. Scale
- (10 marks)
- (c) List five (5) effects caused by ozone depletion.
- (5 marks)
- (d) List five (5) effects caused by global warming
- (5 marks)
- (e) List five (5) GHGs (Green House Gases).
- (5 marks)

**SECTION B (Total: 40 marks)****INSTRUCTION: Answer ONE (1) question only****Question 4**

Refer to Appendix and Table attached.

Given:

A once-thru condenser:

Methyl orange alkalinity	=	80 ppm as CaCO <sub>3</sub>
Calcium hardness	=	85 ppm as CaCO <sub>3</sub>
Total solids	=	250 ppm
pH	=	7.5
Condensing water temperature	=	110°F

Determine the:

(a). Langelier Saturation Index ( $I_s$ )

(10 marks)

(b). Scaling tendency

(20 marks)

(c). Ryznar Stability Index

(10 marks)

**Question 5**

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  $\text{CaCO}_3$

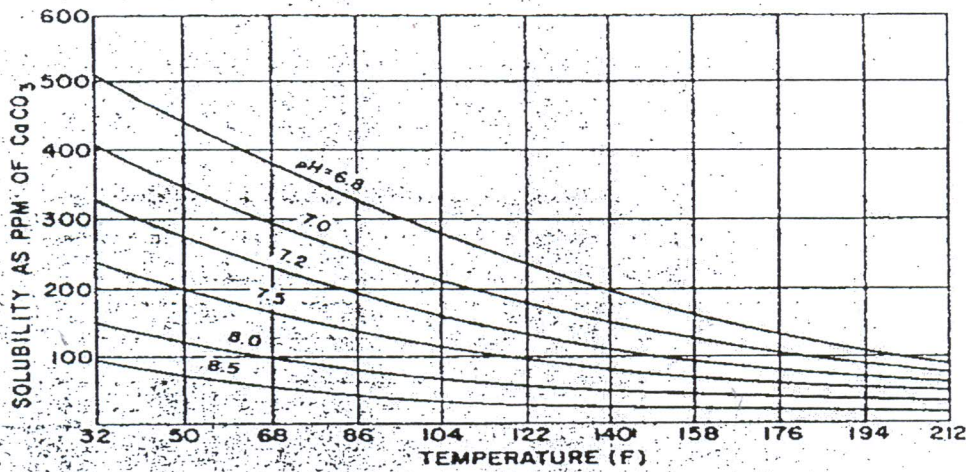
Methy orange alkalinity in recirculating water not to exceed 170 ppm as  $\text{CaCO}_3$

Determine the:

- (a). Cycle concentration (8 marks)
- (b). Re-circulated water quantity (gpm) (8 marks)
- (c). Evaporation loss (gpm) (8 marks)
- (d). Bleed-off requirement (gpm) (8 marks)
- (e). Make-up water (gpm) (8 marks)

**END OF QUESTION**

# TECHNICAL DOCUMENTS



NOTE: pH values at approximately 73 F.  
 Chart 1: Solubility as ppm CaCO<sub>3</sub> 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

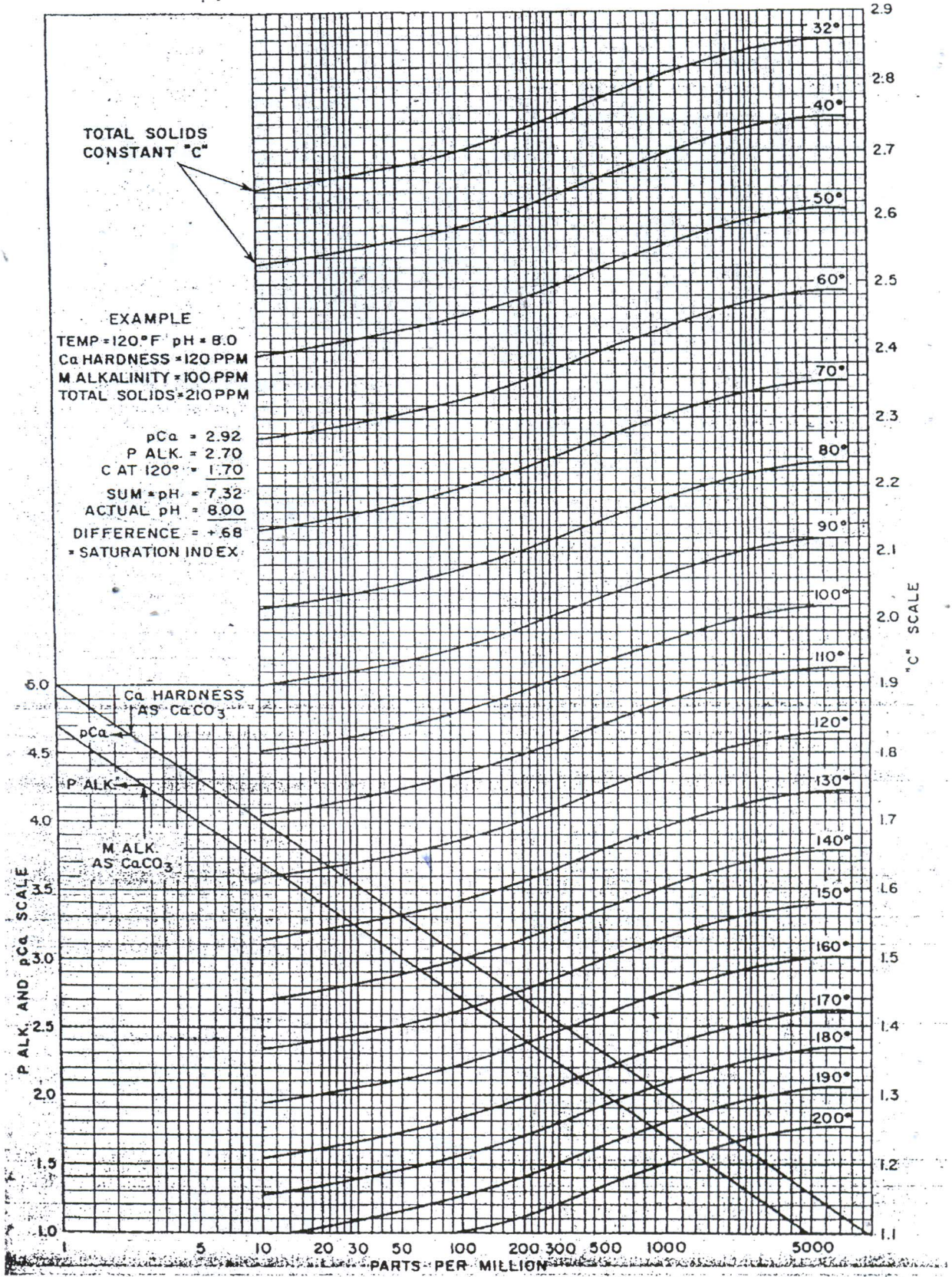


Chart 2: Langelier Saturation Index



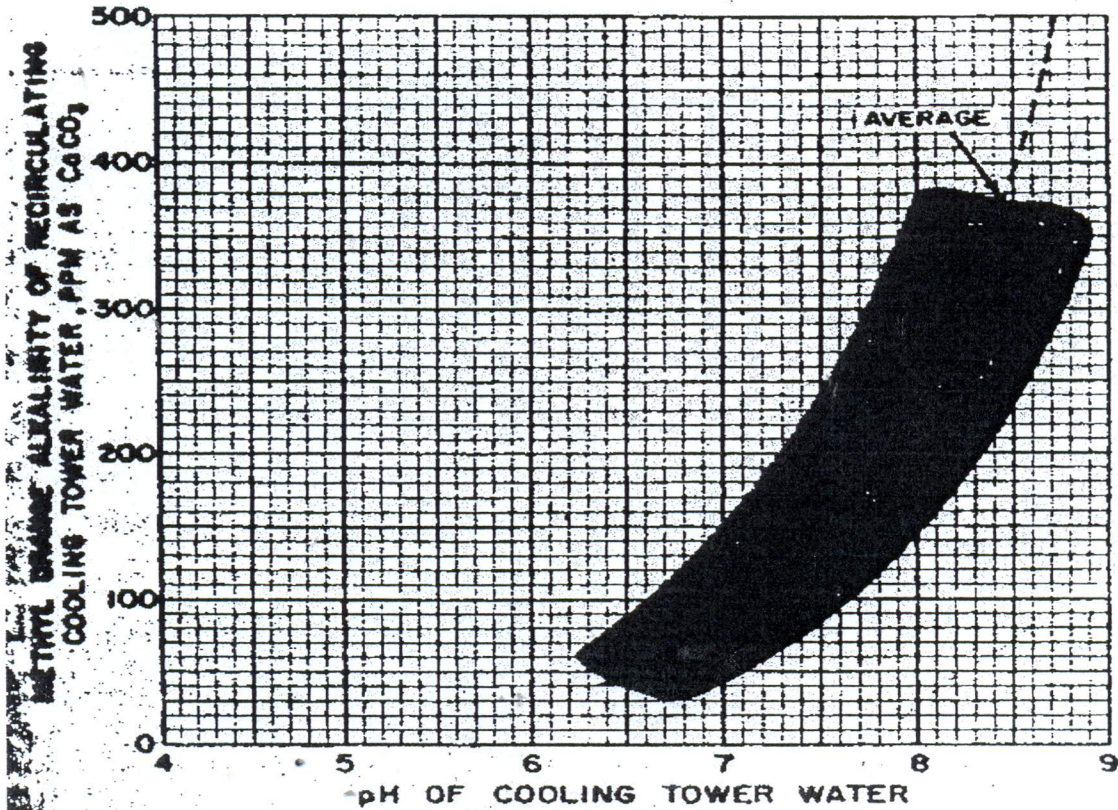


Chart 4: Expected pH of cooling Tower water

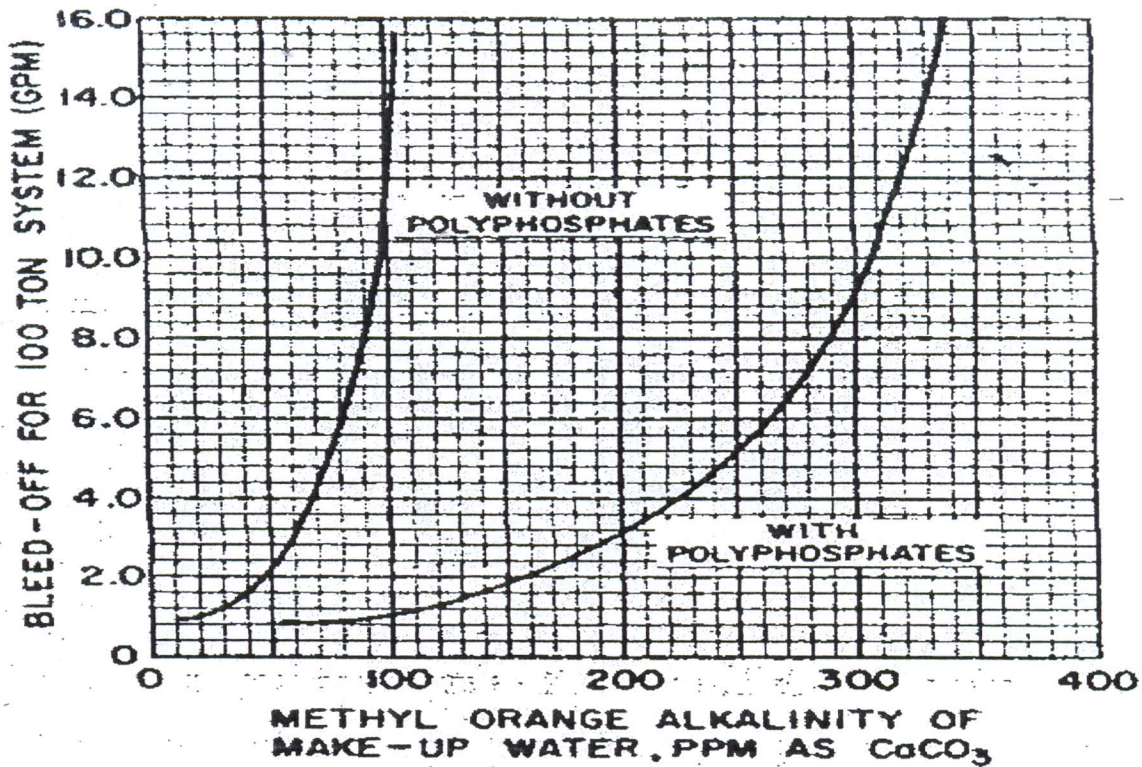


Chart 4: Bleed-off Required to prevent scale formation (100 Ton system)

