



**UNIVERSITI KUALA LUMPUR
Malaysia France Institute**

**FINAL EXAMINATION
JANUARY 2010 SESSION**

SUBJECT CODE : FRB 10402
SUBJECT TITLE : REFRIGERATION FLUID
LEVEL : BACHELOR
TIME / DURATION : 12.30pm – 2.30pm
(2 HOURS)
DATE : 29 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 **FIVE (5)** questions. Answer **ALL** questions.
6. Answer **ALL** questions in English.

THERE ARE 4 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

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

QUESTION 1

a) What are the functions of a refrigerant in a refrigeration cycle?

(5 marks)

b) Explain the phase change of a refrigerant which occurs in the condenser and evaporator of a refrigeration cycle.

(5 marks)

c) What is the function of refrigerant oils in a refrigeration process? List 5 ideal characteristics of refrigerant oils.

(10 marks)

QUESTION 2

a) Describe the refrigerating properties of ammonia for use in domestic and commercial types of refrigerators.

(10 marks)

b) Discuss from an economical point of view whether sulphur dioxide or carbon dioxide is preferred as a refrigerant.

(10 marks)

QUESTION 3

a) Consider a refrigerant system using refrigerant R22 as the working fluid. If the refrigerator is to operate in an environment at 35°C, determine:

1) What is the optimum pressure to which the refrigerant should be compressed?

(5 marks)

2) Why?

(5 marks)

b) What is an azeotrope?

(5 marks)

c) Give some examples to indicate its importance.

(5 marks)

QUESTION 4

a) What is the standard color of R22, R134a, R407A, and CO₂ refrigerant cylinder respectively?

(8 marks)

b) Highlight the two main advantages of CO₂ as refrigerant?

(4 marks)

c) At molecular structure level, what are essential differences between methane, ethane and propane.

(8 marks)

QUESTION 5

a) In the charging of refrigerant by temperature reading, describe 4 essential procedures which must be observed.

(10 marks)

b) Ozone depletion material are by laws are required to recapture and not release to the atmosphere. Describe the available method for the recovery, recycle and reuse of such refrigerant?

(10 marks)

END OF QUESTION

Table of saturated values for: R134a, CH₂FCF₃, 1,1,1,2-tetrafluoroethane

T °C	p Bar	v _l dm ³ /kg	v _g m ³ /kg	h _l kJ/kg	h _g kJ/kg	R kJ/kg	s _l kJ/(kg K)	s _g kJ/(kg K)
10.00	4.145	0.7927	0.04913	213.44	402.89	189.45	1.0480	1.7170
11.00	4.286	0.7949	0.04756	214.80	403.44	188.64	1.0527	1.7166
12.00	4.429	0.7971	0.04604	216.17	404.00	187.83	1.0575	1.7162
13.00	4.577	0.7994	0.04458	217.54	404.55	187.01	1.0623	1.7158
14.00	4.728	0.8016	0.04318	218.92	405.10	186.18	1.0670	1.7154
15.00	4.883	0.8039	0.04183	220.30	405.64	185.34	1.0718	1.7150
16.00	5.042	0.8062	0.04052	221.68	406.18	184.50	1.0765	1.7146
17.00	5.204	0.8085	0.03927	223.07	406.72	183.66	1.0813	1.7142
18.00	5.371	0.8109	0.03806	224.44	407.26	182.82	1.0859	1.7139
19.00	5.541	0.8133	0.03690	225.84	407.80	181.96	1.0907	1.7135
20.00	5.716	0.8157	0.03577	227.23	408.33	181.09	1.0954	1.7132
21.00	5.895	0.8182	0.03469	228.64	408.86	180.22	1.1001	1.7128
22.00	6.078	0.8206	0.03365	230.05	409.38	179.34	1.1049	1.7125
23.00	6.265	0.8231	0.03264	231.46	409.91	178.45	1.1096	1.7122
24.00	6.457	0.8257	0.03166	232.87	410.42	177.55	1.1143	1.7118
25.00	6.653	0.8283	0.03072	234.29	410.94	176.65	1.1190	1.7115
26.00	6.853	0.8309	0.02982	235.72	411.45	175.73	1.1237	1.7112
27.00	7.058	0.8335	0.02894	237.15	411.96	174.81	1.1285	1.7109
28.00	7.267	0.8362	0.02809	238.58	412.47	173.89	1.1332	1.7106
29.00	7.482	0.8389	0.02727	240.02	412.97	172.95	1.1379	1.7103
30.00	7.701	0.8416	0.02648	241.46	413.47	172.00	1.1426	1.7100
31.00	7.924	0.8444	0.02572	242.91	413.96	171.05	1.1473	1.7097
32.00	8.153	0.8473	0.02498	244.36	414.45	170.09	1.1520	1.7094
33.00	8.386	0.8501	0.02426	245.82	414.94	169.12	1.1567	1.7091
34.00	8.625	0.8530	0.02357	247.28	415.42	168.14	1.1614	1.7088
35.00	8.868	0.8560	0.02290	248.75	415.90	167.15	1.1661	1.7085
36.00	9.117	0.8590	0.02225	250.22	416.37	166.15	1.1708	1.7082
37.00	9.371	0.8620	0.02162	251.70	416.84	165.14	1.1755	1.7079
38.00	9.630	0.8651	0.02102	253.18	417.30	164.12	1.1802	1.7077
39.00	9.894	0.8682	0.02043	254.67	417.76	163.09	1.1849	1.7074
40.00	10.164	0.8714	0.01986	256.16	418.21	162.05	1.1896	1.7071
41.00	10.439	0.8747	0.01930	257.66	418.66	161.00	1.1943	1.7068
42.00	10.720	0.8779	0.01877	259.16	419.11	159.94	1.1990	1.7065
43.00	11.007	0.8813	0.01825	260.67	419.54	158.87	1.2037	1.7062
44.00	11.299	0.8847	0.01774	262.19	419.98	157.79	1.2084	1.7059
45.00	11.597	0.8882	0.01726	263.71	420.40	156.69	1.2131	1.7056
46.00	11.901	0.8917	0.01678	265.24	420.83	155.59	1.2178	1.7053
47.00	12.211	0.8953	0.01632	266.77	421.24	154.47	1.2225	1.7050
48.00	12.526	0.8989	0.01588	268.32	421.65	153.33	1.2273	1.7047
49.00	12.848	0.9026	0.01544	269.86	422.05	152.19	1.2320	1.7044
50.00	13.176	0.9064	0.01502	271.42	422.44	151.03	1.2367	1.7041
51.00	13.510	0.9103	0.01461	272.98	422.83	149.85	1.2414	1.7037
52.00	13.851	0.9142	0.01421	274.55	423.21	148.66	1.2462	1.7034
53.00	14.198	0.9182	0.01383	276.13	423.59	147.46	1.2509	1.7030
54.00	14.552	0.9223	0.01345	277.71	423.95	146.24	1.2557	1.7027
55.00	14.912	0.9265	0.01309	279.30	424.31	145.01	1.2604	1.7023
56.00	15.278	0.9308	0.01273	280.90	424.66	143.75	1.2652	1.7019
57.00	15.652	0.9351	0.01239	282.51	424.99	142.49	1.2700	1.7015
58.00	16.032	0.9396	0.01205	284.13	425.32	141.20	1.2747	1.7011
59.00	16.419	0.9441	0.01172	285.75	425.64	139.89	1.2795	1.7007
60.00	16.813	0.9488	0.01141	287.39	425.96	138.57	1.2843	1.7003
61.00	17.215	0.9536	0.01110	289.03	426.26	137.23	1.2892	1.6998
62.00	17.623	0.9585	0.01079	290.68	426.54	135.86	1.2940	1.6994
63.00	18.039	0.9635	0.01050	292.35	426.82	134.47	1.2988	1.6989
64.00	18.462	0.9687	0.01021	294.02	427.09	133.07	1.3037	1.6983
65.00	18.893	0.9739	0.00993	295.71	427.34	131.63	1.3085	1.6978

Printed: 06/03/09. 15:08. Reference: D.P.Wilson & R.S.Basu, ASHRAE Transactions 1988, Vol. 94 part 2.

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Table of saturated values for: R22, CHClF₂, Chlorodifluoromethane

T °C	p Bar	v _l dm ³ /kg	v _g m ³ /kg	h _l kJ/kg	h _g kJ/kg	R kJ/kg	s _l kJ/(kg K)	s _g kJ/(kg K)
20.00	9.099	0.8243	0.02601	224.07	411.93	187.86	1.0839	1.7247
21.00	9.356	0.8269	0.02529	225.31	412.21	186.90	1.0880	1.7234
22.00	9.619	0.8295	0.02459	226.56	412.49	185.94	1.0922	1.7221
23.00	9.887	0.8322	0.02391	227.80	412.77	184.96	1.0963	1.7209
24.00	10.160	0.8349	0.02326	229.05	413.03	183.98	1.1005	1.7196
25.00	10.439	0.8376	0.02263	230.31	413.30	182.99	1.1046	1.7183
26.00	10.723	0.8404	0.02201	231.57	413.56	181.99	1.1087	1.7171
27.00	11.014	0.8432	0.02142	232.83	413.81	180.98	1.1129	1.7158
28.00	11.309	0.8461	0.02084	234.10	414.06	179.96	1.1170	1.7146
29.00	11.611	0.8490	0.02029	235.37	414.30	178.93	1.1211	1.7133
30.00	11.919	0.8519	0.01974	236.65	414.54	177.89	1.1253	1.7121
31.00	12.232	0.8549	0.01922	237.93	414.77	176.84	1.1294	1.7108
32.00	12.552	0.8579	0.01871	239.22	415.00	175.78	1.1335	1.7096
33.00	12.878	0.8610	0.01822	240.51	415.22	174.71	1.1377	1.7083
34.00	13.210	0.8641	0.01774	241.80	415.43	173.63	1.1418	1.7071
35.00	13.548	0.8673	0.01727	243.10	415.64	172.54	1.1459	1.7058
36.00	13.892	0.8705	0.01682	244.41	415.84	171.43	1.1500	1.7046
37.00	14.243	0.8738	0.01638	245.71	416.03	170.32	1.1542	1.7033
38.00	14.601	0.8771	0.01595	247.03	416.22	169.19	1.1583	1.7021
39.00	14.965	0.8805	0.01554	248.35	416.40	168.05	1.1624	1.7008
40.00	15.335	0.8839	0.01514	249.67	416.57	166.90	1.1666	1.6995
41.00	15.712	0.8874	0.01475	251.00	416.74	165.73	1.1707	1.6983
42.00	16.097	0.8909	0.01437	252.34	416.89	164.55	1.1748	1.6970
43.00	16.487	0.8946	0.01400	253.68	417.04	163.36	1.1790	1.6957
44.00	16.885	0.8983	0.01364	255.03	417.18	162.15	1.1831	1.6944
45.00	17.290	0.9020	0.01329	256.38	417.32	160.93	1.1873	1.6931
46.00	17.702	0.9058	0.01295	257.74	417.44	159.70	1.1914	1.6918
47.00	18.121	0.9097	0.01261	259.11	417.56	158.45	1.1956	1.6905
48.00	18.548	0.9137	0.01229	260.49	417.66	157.18	1.1998	1.6892
49.00	18.982	0.9178	0.01198	261.87	417.76	155.90	1.2039	1.6878
50.00	19.423	0.9219	0.01167	263.25	417.85	154.60	1.2081	1.6865

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