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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013**

COURSE NAME : BOILER ENGINEERING
COURSE CODE : DAM 26503
PROGRAMME : 3 DAI
EXAMINATION DATE : OCTOBER 2012
DURATION : 2 ½ HOURS
INSTRUCTIONS : ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF TEN (10) PAGES

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SOALAN DALAM BAHASA MELAYU

- S1. (a) Nyatakan **lima (5)** kategori dandang berdasarkan penggunaan bahan bakar.
(5 markah)
- (b) Arang batu merupakan salah satu bahan bakar yang utama bagi dandang jenis tiub air (*water tube*). Apakah yang dimaksudkan dengan arang batu dan terangkan **tiga (3)** jenis arang batu.
(5 markah)
- (c) Sebuah dandang menghasilkan tekanan sebanyak 15 bar dan menghasilkan 8.5 kg air bagi satu kg arang batu daripada air suapan masukan dandang bersuhu 40°C.
- i. Tentukan pemewapan setara daripada suhu 100°C jika pepecahan kekeringan stim ialah 0.96 pada injap berhenti.
(7 markah)
- ii. Jika nilai kalori arang batu = 6000 kcal / kg, kira kecekapan dandang.
(8 markah)
- Keterangan: 1 kcal = 4.184 kJ.
- S2. (a) Terdapat istilah didalam rekabentuk kejuruteraan dandang. Terangkan istilah-istilah berikut.
- i. Rekabentuk tekanan
ii. Rekabentuk suhu
iii. Rekabentuk margin
(8 markah)
- (b) Kirakan daya tegasan longitud dan lilitan bagi dandang yang mempunyai tekanan 15 bar dan berdiameter 1 m serta panjang 3.7 m. Tebal drum bagi dandang tersebut 0.013 m.
(17 markah)
- S3. (a) Nyatakan perbezaan antara turbin *impulse* dan *reaction*. Terangkan prinsip operasi bagi kedua-dua turbin tersebut.
(14 markah)
- (b) Terangkan kaedah yang digunakan untuk meningkatkan kecekapan turbin.
(5 markah)
- (c) Nyatakan **tiga (3)** jenis kerosakan atau kegagalan biasa yang berlaku pada turbin stim dan nyatakan punca kerosakan tersebut.
(6 markah)

- S4.** (a) Lukiskan litar asas bagi sistem loji kuasa stim bagi *Kitar Rankine*.
(8 markah)
- (b) Senaraikan **tiga (3)** jenis perangkap stim dan terangkan prinsip setiap operasi perangkap stim tersebut.
(12 markah)
- (c) Apakah yang dimaksudkan dengan perangkap stim. Terangkan kegunaannya.
(5 markah)
- S5.** (a) Merujuk pada **Rajah S5(a)** namakan setiap peralatan dan terangkan fungsi setiap peralatan tersebut yang terdapat pada dandang.
(12 markah)
- (b) Apakah tindakan yang perlu diambil semasa tolok kaca (*gauge glass*) pecah.
(6 markah)
- (c) Mengapakah tolok tekanan menggunakan '*Syphoon Pipe*' seperti di dalam **Rajah S5(b)**.
(7 markah)
- S6.** (a) Huraikan dengan lengkap dandang simpan kering dan dandang simpan basah.
(8 markah)
- (b) Nyatakan **empat (4)** jenis masalah yang biasa berlaku di dalam dandang.
(7 markah)
- (c) Terangkan sebab karat boleh berlaku pada tiub dandang dan langkah-langkah mencegah karat tersebut.
(10 markah)

SOALAN DALAM BAHASA INGGERIS

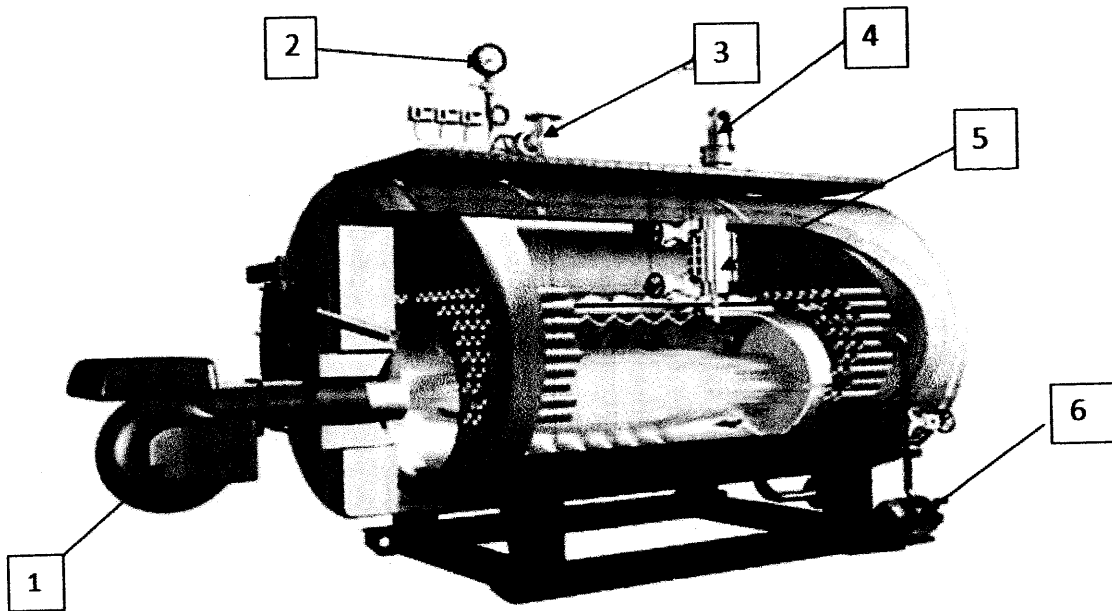
- Q1.** (a) State the **five (5)** classified of boiler based on by the fuel used. (5 marks)
- (b) Coal is one of the main fuel for water tube boiler. Describe this coal and explain **three (3)** types of coal. (5 marks)
- (c) A boiler is working at 15 bar and evaporate 8.5 kg of water per kg of coal fired from the boiler feed water entering 40°C.
- i. Determine the equivalent evaporation from at 100°C if the steam is 0.96 dry at the stop valve. (7 marks)
- ii. If caloric value of coal 6000 kcal/kg, calculate boiler efficiency. (8 marks)
- Hint : 1 kcal = 4.184 kJ.
- Q2.** (a) There are terms in the design of the boiler engineering. Explain the following terms. (8 marks)
- i. Design pressure
ii. Design temperature
iii. Design margin
- (b) Calculate the longitudinal and circumferential stresses on a boiler with steam pressure of 15 bar and 1 m inside diameter drum that is 3.7 m long. The thickness of the drum is 0.013 m. (17 marks)
- Q3.** (a) Describe the differences between impulse and reaction turbines. Explain the operating principle for both type of turbine. (14 marks)
- (b) Explain the method to increase the turbine efficiency. (5 marks)
- (c) State **three (3)** types of normal failure or damage always occur in steam turbine and give the reason for this failure. (6 marks)

- Q4.** (a) Draw the basic diagram for Rankine Cycle in steam power plant. (8 marks)
- (b) State **three (3)** type of steam trap and explain the operating principal of all steam traps. (12 marks)
- (c) Explain the definition of steam trap. Give the usage of steam trap. (5 marks)
- Q5.** (a) With reference to **Figure Q5(a)** label all the equipment and explain the function of each components that exist on the boiler. (12 marks)
- (b) Explain the actions that need to be taken during broken gauge glass. (6 marks)
- (c) Explain the pressure gauge use the 'Syphoon Pipe' as shown in **Figure Q5(b)**. (7 marks)
- Q6.** (a) Describe the boiler keep dry and boiler keep wet. (8 marks)
- (b) State the **four (4)** types of problems that always happen in the boiler. (7 marks)
- (c) Explain the cause of rust can occur in boiler tube and how to prevent these issues. (10 marks)

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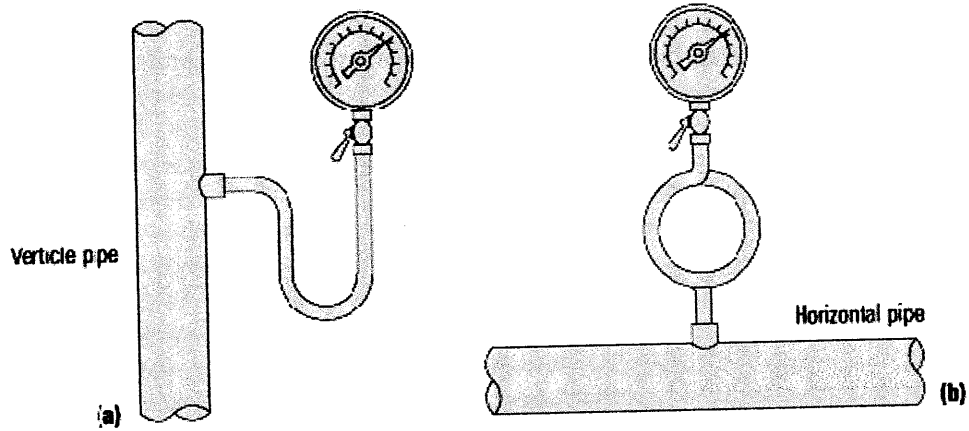


RAJAH S5(a) / FIGURE Q5(a)

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RAJAH S5(b) / FIGURE Q5(b)

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12.4 Steam Tables

SATURATED STEAM - TEMPERATURE TABLE

T °C	P bar	Spec. vol. m ³ =kg		Int. Ener. kJ/kg		Enthalpy kJ/kg		Entropy kJ=(kg°K)	
		Sat. liq. v _r	Sat. vap. v _g	Sat. liq. u _r	Sat. vap. u _g	Sat. liq. h _r	Sat. vap. h _g	Sat. liq. s _r	Sat. vap. s _g
0.01	0.0061	1.0002	206.1	0.01	2376	0.01	2501	0	9.156
4	0.0081	1.0001	157.2	16.79	2381	16.79	2509	0.061	9.051
5	0.0087	1.0001	147.1	21.00	2383	21	2511	0.0762	9.026
6	0.0093	1.0001	137.7	25.21	2384	25.21	2512	0.0912	9.000
8	0.0107	1.0001	120.9	33.61	2387	33.61	2516	0.1212	8.950
10	0.0123	1.0001	106.4	42.01	2389	42.01	2520	0.151	8.901
11	0.0131	1.0007	99.86	46.19	2391	46.19	2522	0.1658	8.876
12	0.0140	1.0007	93.79	50.40	2392	50.4	2523	0.1806	8.852
13	0.0150	1.0007	88.13	54.59	2393	54.59	2525	0.1953	8.829
14	0.0160	1.0007	82.85	58.80	2394	58.8	2527	0.2099	8.805
15	0.0170	1.0007	77.93	62.99	2395	62.99	2529	0.2245	8.781
16	0.0182	1.0013	73.34	67.17	2397	67.17	2531	0.239	8.758
17	0.0194	1.0013	69.05	71.36	2399	71.36	2533	0.2535	8.735
18	0.0206	1.0013	65.04	75.57	2400	75.57	2534	0.2679	8.712
19	0.0220	1.0013	61.30	79.76	2401	79.76	2536	0.2823	8.690
20	0.0234	1.002	57.79	83.94	2403	83.94	2538	0.2966	8.667
21	0.0249	1.002	54.52	88.13	2404	88.13	2540	0.3108	8.645
22	0.0264	1.002	51.45	92.32	2406	92.32	2542	0.3251	8.623
23	0.0281	1.0026	48.58	96.50	2407	96.5	2544	0.3392	8.601
24	0.0298	1.0026	45.89	100.7	2409	100.7	2545	0.3533	8.579
25	0.0317	1.0032	43.36	104.9	2410	104.9	2547	0.3673	8.558
26	0.0336	1.0032	41.00	109.0	2411	109.0	2549	0.3814	8.537
27	0.0357	1.0032	38.78	113.2	2412	113.2	2551	0.3953	8.515
28	0.0378	1.0038	36.69	117.4	2414	117.4	2553	0.4093	8.495
29	0.0401	1.0038	34.73	121.6	2415	121.6	2554	0.4231	8.474
30	0.0425	1.0045	32.90	125.8	2416	125.8	2556	0.4369	8.453
31	0.0450	1.0045	31.17	130.0	2418	130.0	2558	0.4507	8.433
32	0.0476	1.0051	29.54	134.1	2419	134.1	2560	0.4644	8.413
33	0.0503	1.0051	28.01	138.3	2421	138.3	2562	0.478	8.393
34	0.0532	1.0057	26.57	142.5	2422	142.5	2563	0.4917	8.373
35	0.0563	1.0057	25.22	146.7	2423	146.7	2565	0.5053	8.353
36	0.0595	1.0063	23.94	150.8	2425	150.8	2567	0.5188	8.333
38	0.0663	1.007	21.60	159.2	2427	159.2	2571	0.5457	8.295
40	0.0738	1.0076	19.52	167.5	2430	167.5	2574	0.5725	8.257
45	0.0959	1.010	15.26	198.4	2437	188.4	2583	0.6386	8.165
50	0.1235	1.012	12.03	209.3	2443	209.3	2592	0.7037	8.076
55	0.1576	1.015	9.569	230.2	2450	230.2	2601	0.7679	7.991
60	0.1994	1.017	7.671	251.1	2457	251.1	2610	0.8311	7.910
65	0.2503	1.020	6.197	272.0	2463	272.0	2618	0.8934	7.831
70	0.3119	1.023	5.042	293.0	2470	293.0	2627	0.9549	7.755
75	0.3858	1.026	4.131	313.9	2476	313.9	2635	1.016	7.682
80	0.4739	1.029	3.407	334.8	2482	334.9	2644	1.075	7.612

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CHAPTER 12. SUPPLEMENTAL MATERIALS

SATURATED STEAM - TEMPERATURE TABLE (Continued)

T °C	P bar	Spec. vol. m ³ /kg		Int. Ener. kJ/kg		Enthalpy kJ/kg		Entropy kJ/(kg°K)	
		Sat. liq. v _f	Sat. vap. v _g	Sat. liq. u _f	Sat. vap. u _g	Sat. liq. h _f	Sat. vap. h _g	Sat. liq. s _f	Sat. vap. s _g
85	0.5793	1.033	2.828	355.8	2488	355.9	2652	1.134	7.544
90	0.7013	1.036	2.361	376.8	2494	376.9	2660	1.193	7.479
95	0.8455	1.039	1.982	397.9	2501	398.0	2668	1.250	7.416
100	1.013	1.044	1.673	418.9	2507	419.0	2676	1.307	7.355
110	1.433	1.052	1.21	461.1	2518	461.3	2691	1.418	7.239
120	1.985	1.060	0.892	503.5	2529	503.7	2706	1.528	7.130
130	2.701	1.069	0.669	546.0	2540	546.3	2720	1.634	7.027
140	3.613	1.080	0.509	588.7	2550	589.1	2734	1.739	6.930
150	4.758	1.091	0.393	631.7	2559	632.2	2746	1.842	6.838
160	6.178	1.102	0.307	674.9	2568	675.5	2758	1.943	6.750
170	7.916	1.114	0.243	718.3	2576	719.2	2769	2.042	6.666
180	10.02	1.127	0.194	762.1	2584	763.2	2778	2.140	6.586
190	12.54	1.141	0.157	806.2	2589	807.6	2786	2.236	6.508
200	15.54	1.156	0.127	850.6	2596	852.4	2793	2.331	6.432
210	19.06	1.172	0.104	895.5	2600	897.8	2798	2.425	6.358
220	23.18	1.190	0.086	940.8	2603	943.6	2802	2.518	6.286
230	27.95	1.209	0.072	986.7	2603	990.1	2804	2.610	6.215
240	33.44	1.229	0.06	1033	2603	1037.3	2804	2.702	6.144
250	39.73	1.251	0.05	1080	2603	1085.3	2802	2.793	6.073
260	46.88	1.275	0.042	1128	2600	1134.4	2797	2.884	6.002
270	54.98	1.302	0.036	1177	2592	1184.5	2790	2.975	5.930
280	64.11	1.332	0.03	1227	2587	1236.0	2780	3.067	5.857
290	74.36	1.365	0.026	1279	2573	1289.0	2766	3.159	5.782
300	85.81	1.403	0.022	1332	2560	1344.0	2749	3.253	5.704
320	112.7	1.499	0.015	1445	2531	1461.5	2700	3.448	5.536
340	145.9	1.638	0.011	1570	2462	1594.1	2622	3.659	5.336
360	186.5	1.893	0.007	1725	2351	1760.5	2481	3.915	5.053
374.14	220.9	3.155	0.003155	2030	2030	2099.3	2099	4.430	4.430

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SUPERHEATED STEAM

v in m³/kg, u in kJ/kg, h in kJ/kg, s in kJ/(kg^oK)

P= 40 bar					P= 60 bar			
T	v	u	h	s	v	u	h	s
280	0.0555	2680	2902	6.257	0.0332	2605	2804	5.925
320	0.062	2767	3015	6.455	0.0387	2720	2952	6.184
360	0.0679	2846	3117	6.621	0.0433	2811	3071	6.378
400	0.0734	2920	3213	6.769	0.0474	2893	3177	6.541
450	0.08	3010	3330	6.936	0.0521	2989	3302	6.719
500	0.0864	3100	3445	7.090	0.0567	3082	3422	6.880
550	0.0927	3189	3560	7.233	0.061	3175	3541	7.029
600	0.0988	3279	3674	7.369	0.0653	3267	3658	7.168
650	0.1049	3370	3790	7.497	0.0694	3360	3776	7.299
700	0.1109	3462	3906	7.620	0.0735	3453	3894	7.423
750	0.1169	3556	4023	7.737	0.0776	3547	4013	7.542

SUPERHEATED STEAM

v in m³/kg, u in kJ/kg, h in kJ/kg, s in kJ/(kg^oK)

P= 80 bar					P= 100 bar			
T	v	u	h	s	v	u	h	s
320	0.0268	2663	2877	5.949	0.0193	2588	2781	5.710
360	0.0309	2773	3020	6.182	0.0233	2729	2962	6.006
400	0.0343	2864	3138	6.363	0.0264	2832	3096	6.212
450	0.0382	2966	3272	6.555	0.0297	2944	3241	6.419
500	0.0417	3065	3398	6.724	0.0328	3046	3374	6.597
550	0.0451	3160	3521	6.878	0.0356	3145	3501	6.756
600	0.0495	3254	3642	7.020	0.0384	3241	3625	6.903
650	0.0517	3349	3762	7.154	0.041	3338	3748	7.040
700	0.0548	3444	3882	7.281	0.0436	3434	3870	7.169
750	0.0579	3540	4003	7.402	0.0461	3532	3993	7.291

SUPERHEATED STEAM

v in m³/kg, u in kJ/kg, h in kJ/kg, s in kJ/(kg^oK)

P= 120 bar					P= 140 bar			
T	v	u	h	s	v	u	h	s
360	0.0181	2678	2996	5.836	0.0142	2618	2816	5.660
400	0.0211	2798	3051	6.075	0.0172	2761	3002	5.945
450	0.0241	2919	3208	6.300	0.0201	2893	3174	6.192
500	0.0268	3027	3348	6.487	0.0225	3007	3322	6.390
550	0.0293	3129	3480	6.653	0.0247	3113	3459	6.562
600	0.0316	3229	3608	6.804	0.0268	3216	3591	6.717
650	0.0339	3327	3734	6.944	0.0288	3316	3720	6.860
700	0.0361	3425	3858	7.075	0.0307	3416	3846	6.994
750	0.0382	3524	3982	7.199	0.0326	3515	3972	7.120
800	0.0403	3611	4095	7.305	0.0344	3604	4085	7.227