



1. 試求下列方程式的積分因子並求解 (10%)

$$2xy^3 dx + (3x^2 y^2 + x^2 y^3 + 1) dy = 0$$

2. 某陶瓷隔熱體以 400°C 烘烤，然後放在溫度為 25°C 的房間內冷卻。4 分鐘後，其溫度為 200°C，則 8 分鐘後的溫度將為何？(10%)

3. 試求下列微分方程式之特解 (10%)

$$y'' + 2y' + 5y = e^{-x} [(6 - 16x) \cos 2x - (8 + 8x) \sin 2x]$$

4. 試以拉式變換法求解下列初值問題 (10%)

$$y' + y = f(t), \quad y(0) = 2, \quad y'(0) = -1$$

$$\text{其中 } f(t) = \begin{cases} 1, & 0 \leq t < \pi/2 \\ -1, & t \geq \pi/2 \end{cases}$$

5. 試解下列微分方程式，其中  $D = \frac{d}{dx}$  (10%)

$$[(D+1)^2 + 1]^2 (D-1)^3 (D'+1) D^2 y = 0$$

6. 試求解  $f(x) = xe^{\frac{x}{2}}$  的相對極值及反曲點？並繪出圖形？(15%)

7. 試列出無窮級數收斂或發散的判斷有那些方法？並簡要說明各方法的適用性及優點？(10%)

8. 試求解玫瑰三瓣線  $r = 2 \sin 3\theta$  中的面積？(10%)

9. 求曲面  $z^2 = xy + 1$  上與 (0,0,0) 最近之點坐標？(10%)

10. 求重積分  $\int_0^4 \int_{\sqrt{y}}^2 \sqrt{1+x^3} dx dy$  ? (5%)



1. 解釋下列名詞及其意涵：(20%)

- (1) Central limit theorem
- (2) Population vs. Sample
- (3) P value
- (4) T-test

2. 假設 A、B 為某工廠兩個製程，兩製程中 X 污染物質含量是常態分佈，其平均數分別為  $\mu_1$ 、 $\mu_2$ ，且有共同的標準差  $\sigma$ ，若各收集 5 天 A、B 兩個製程 X 污染濃度含量 (ppm) 如下表：

A 製程 85 82 89 88 84

B 製程 92 87 86 85 84

- (1) 試檢定兩個製程 X 濃度的標準差是否相等？( $\alpha = 0.05$ )
- (2)  $\alpha = 0.05$ ，試檢定 A、B 兩個製程 X 平均濃度含量有無差異？(20%)

3 假如某公司有一條生產線生產 0.5 升飲料玻璃瓶，已知其平均內壓強度 ( $\mu$ ) 為 216.5 psi，內壓強度之標準偏差 ( $\sigma$ ) 為 12 psi，該公司另有一生產線生產一升飲料玻璃瓶，已知其平均內壓強度 ( $\mu$ ) 為 214.5 psi，內壓強度之標準偏差 ( $\sigma$ ) 為 11 psi，且兩者均為常態分布：

- (1) 試問 0.5 升飲料玻璃瓶與一升飲料玻璃瓶內壓強度差之平均值與標準偏差為何；(10%)
- (2) 試問 0.5 升飲料玻璃瓶內壓強度比一升飲料玻璃瓶內壓强度高 10 psi 之機率為何；(5%)

4. 某公司專門生產各式省電燈泡，品管部門為瞭解其 20W 省電燈泡平均使用壽命 ( $\mu$ )，於某一生產線上隨機抽取 25 個 ( $n$ ) 20W 省電燈泡，並分析出此樣本之平均使用壽命 ( $\bar{x}$ ) 為 8050 小時。

- (1) 倘依過去生產類似省電燈泡之經驗，得知 20W 省電燈泡使用壽命之標準偏差 ( $\sigma$ ) 為 1000 小時，請問該 20W 省電燈泡平均使用壽命 ( $\mu$ ) 之 95% 信賴區間為何？(10%)
- (2) 假如品管工程師希望對於 20W 省電燈泡平均使用壽命 ( $\mu$ ) 有較精確的估計，當他的期望為：信賴係數 99%，抽樣誤差小於 50 小時，他應抽取多少個 20W 省電燈泡來分析，方可達成此目標 (已知 20W 省電燈泡使用壽命之標準偏差 ( $\sigma$ ) 為 1000 小時)。(10%)
- (3) 假如該公司老闆宣稱傳統 20W 省電燈泡平均使用壽命 ( $\mu$ ) 為 8000 小時，試問同前述抽取 25 個 ( $n$ ) 20W 省電燈泡，省電燈泡樣本平均使用壽命 ( $\bar{x}$ ) 為 8060 小



時，標準偏差( $\sigma$ )為 1000 小時，該工廠老闆的陳述在顯著水準  $\alpha = 0.05$  情形下可接受嗎？又本抽樣情形之  $p$  值為何？(10%)

在進行上述檢定時由於有抽樣誤差，因此可能發生決策錯誤之情形，本題兩種決策錯誤(Type I Error 與 Type II Error)所指情形為何？(5%)

倘真正 20W 省電燈泡平均使用壽命為 7900 小時，則本題 Type II Error 之機率各為何？檢定力(power)又為何？請就本題之情形解釋檢定力之意義。(10%)



$$\Phi(z) = P(Z \leq z) = \int_{-\infty}^z \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}u^2} du$$

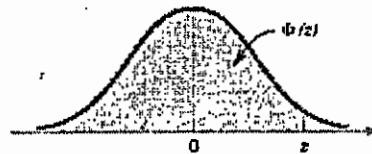


Table II Cumulative Standard Normal Distribution (continued)

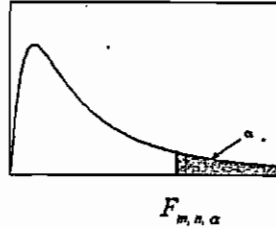
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.500000	0.503989	0.507978	0.511967	0.515953	0.519939	0.522922	0.527903	0.531881	0.535856
0.1	0.539828	0.543795	0.547758	0.551717	0.555676	0.559618	0.563559	0.567495	0.571424	0.575345
0.2	0.579260	0.583166	0.587064	0.590954	0.594835	0.598706	0.602568	0.606420	0.610261	0.614092
0.3	0.617911	0.621719	0.625516	0.629300	0.633072	0.636831	0.640576	0.644309	0.648027	0.651732
0.4	0.655422	0.659097	0.662757	0.666402	0.670031	0.673645	0.677242	0.680822	0.684386	0.687933
0.5	0.691462	0.694974	0.698468	0.701944	0.705401	0.708840	0.712260	0.715661	0.719043	0.722405
0.6	0.725747	0.729069	0.732371	0.735653	0.738914	0.742154	0.745373	0.748571	0.751748	0.754903
0.7	0.758036	0.761148	0.764238	0.767305	0.770350	0.773373	0.776373	0.779350	0.782305	0.785236
0.8	0.788145	0.791030	0.793892	0.796731	0.799546	0.802338	0.805106	0.807850	0.810570	0.813267
0.9	0.815940	0.818589	0.821214	0.823815	0.826391	0.828944	0.831472	0.833977	0.836457	0.838913
1.0	0.841345	0.843752	0.846136	0.848495	0.850830	0.853141	0.855428	0.857699	0.859929	0.862143
1.1	0.864334	0.866500	0.868643	0.870762	0.872857	0.874928	0.876976	0.878999	0.881000	0.882977
1.2	0.884930	0.886860	0.888767	0.890651	0.892512	0.894350	0.896165	0.897958	0.899727	0.901475
1.3	0.903199	0.904902	0.906582	0.908241	0.909877	0.911492	0.913085	0.914657	0.916207	0.917736
1.4	0.919243	0.920730	0.922196	0.923641	0.925066	0.926471	0.927855	0.929219	0.930563	0.931888
1.5	0.933193	0.934478	0.935744	0.936992	0.938220	0.939429	0.940620	0.941792	0.942947	0.944083
1.6	0.945201	0.946301	0.947384	0.948449	0.949497	0.950529	0.951543	0.952540	0.953521	0.954486
1.7	0.955435	0.956367	0.957284	0.958185	0.959071	0.959941	0.960796	0.961636	0.962462	0.963273
1.8	0.964070	0.964852	0.965621	0.966375	0.967116	0.967843	0.968557	0.969258	0.969946	0.970621
1.9	0.971283	0.971933	0.972571	0.973197	0.973810	0.974412	0.975002	0.975581	0.976148	0.976705
2.0	0.977250	0.977784	0.978308	0.978822	0.979325	0.979818	0.980301	0.980774	0.981237	0.981691
2.1	0.982136	0.982571	0.982997	0.983414	0.983823	0.984222	0.984614	0.984997	0.985371	0.985738
2.2	0.986097	0.986447	0.986791	0.987126	0.987455	0.987776	0.988089	0.988396	0.988696	0.988989
2.3	0.989276	0.989556	0.989830	0.990097	0.990358	0.990613	0.990863	0.991106	0.991344	0.991576
2.4	0.991802	0.992024	0.992240	0.992451	0.992656	0.992857	0.993053	0.993244	0.993431	0.993613
2.5	0.993790	0.993963	0.994132	0.994297	0.994457	0.994614	0.994766	0.994915	0.995060	0.995201
2.6	0.995339	0.995473	0.995604	0.995731	0.995855	0.995975	0.996093	0.996207	0.996319	0.996427
2.7	0.996533	0.996636	0.996736	0.996833	0.996928	0.997020	0.997110	0.997197	0.997282	0.997365
2.8	0.997445	0.997523	0.997599	0.997673	0.997744	0.997814	0.997882	0.997948	0.998012	0.998074
2.9	0.998134	0.998193	0.998250	0.998305	0.998359	0.998411	0.998462	0.998511	0.998559	0.998605
3.0	0.998650	0.998694	0.998736	0.998777	0.998817	0.998856	0.998893	0.998930	0.998965	0.998999
3.1	0.999032	0.999065	0.999096	0.999126	0.999155	0.999184	0.999211	0.999238	0.999264	0.999289
3.2	0.999313	0.999336	0.999359	0.999381	0.999402	0.999423	0.999443	0.999462	0.999481	0.999499
3.3	0.999517	0.999533	0.999550	0.999566	0.999581	0.999596	0.999610	0.999624	0.999638	0.999650
3.4	0.999663	0.999675	0.999687	0.999698	0.999709	0.999720	0.999730	0.999740	0.999749	0.999758
3.5	0.999767	0.999776	0.999784	0.999792	0.999800	0.999807	0.999815	0.999821	0.999828	0.999835
3.6	0.999841	0.999847	0.999853	0.999858	0.999864	0.999869	0.999874	0.999879	0.999883	0.999888
3.7	0.999892	0.999896	0.999900	0.999904	0.999908	0.999912	0.999915	0.999918	0.999922	0.999925
3.8	0.999928	0.999931	0.999933	0.999936	0.999938	0.999941	0.999943	0.999946	0.999948	0.999950
3.9	0.999952	0.999954	0.999956	0.999958	0.999959	0.999961	0.999963	0.999964	0.999966	0.999967



表 4. F 分配表 (續 5)

(iii) = 0.025

$$P(F_{m,n} \geq F_{m,n,\alpha}) = \alpha$$



分子  
自  
由  
度  
n

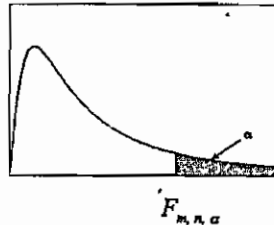
		分子自由度 m								
		1	2	3	4	5	6	7	8	9
1	647.789	799.500	864.163	899.583	921.848	937.111	948.217	956.656	963.287	
2	38.5063	39.0000	39.1655	39.2484	39.2982	39.3315	39.3552	39.3730	39.3869	
3	17.4434	16.0441	15.4392	15.1010	14.8848	14.7347	14.6244	14.5399	14.4731	
4	12.2179	10.6491	9.9792	9.6045	9.3645	9.1973	9.0741	8.9796	8.9047	
5	10.007	8.4336	7.7636	7.3879	7.1464	6.9777	6.8531	6.7572	6.6811	
6	8.8131	7.2599	6.5988	6.2272	5.9876	5.8198	5.6955	5.5996	5.5234	
7	8.0727	6.5415	5.8898	5.5226	5.2852	5.1186	4.9949	4.8993	4.8232	
8	7.5709	6.0595	5.4160	5.0526	4.8173	4.6517	4.5286	4.4333	4.3572	
9	7.2093	5.7147	5.0781	4.7181	4.4844	4.3197	4.1970	4.1020	4.0260	
10	6.9367	5.4564	4.8256	4.4683	4.2361	4.0721	3.9498	3.8549	3.7790	
11	6.7241	5.2559	4.6300	4.2751	4.0440	3.8807	3.7586	3.6638	3.5879	
12	6.5538	5.0959	4.4742	4.1212	3.8911	3.7283	3.6065	3.5118	3.4358	
13	6.4143	4.9653	4.3472	3.9959	3.7667	3.6043	3.4827	3.3880	3.3120	
14	6.2979	4.8567	4.2417	3.8919	3.6634	3.5014	3.3799	3.2853	3.2093	
15	6.1995	4.7650	4.1528	3.8043	3.5764	3.4147	3.2934	3.1987	3.1227	
16	6.1151	4.6867	4.0768	3.7294	3.5021	3.3406	3.2194	3.1248	3.0488	
17	6.0420	4.6189	4.0112	3.6648	3.4379	3.2767	3.1556	3.0610	2.9849	
18	5.9781	4.5597	3.9539	3.6083	3.3820	3.2209	3.0999	3.0053	2.9291	
19	5.9216	4.5075	3.9034	3.5587	3.3327	3.1718	3.0509	2.9563	2.8801	
20	5.8715	4.4613	3.8587	3.5147	3.2891	3.1283	3.0074	2.9128	2.8365	
21	5.8266	4.4199	3.8188	3.4754	3.2501	3.0895	2.9686	2.8740	2.7977	
22	5.7863	4.3828	3.7829	3.4401	3.2151	3.0546	2.9338	2.8392	2.7628	
23	5.7498	4.3492	3.7505	3.4083	3.1835	3.0232	2.9023	2.8077	2.7313	
24	5.7166	4.3187	3.7211	3.3794	3.1548	2.9946	2.8738	2.7791	2.7027	
25	5.6864	4.2909	3.6943	3.3530	3.1287	2.9685	2.8478	2.7531	2.6766	
26	5.6586	4.2655	3.6697	3.3289	3.1048	2.9447	2.8240	2.7293	2.6528	
27	5.6331	4.2421	3.6472	3.3067	3.0828	2.9228	2.8021	2.7074	2.6309	
28	5.6096	4.2205	3.6264	3.2863	3.0626	2.9027	2.7820	2.6872	2.6106	
29	5.5878	4.2006	3.6072	3.2674	3.0438	2.8840	2.7633	2.6686	2.5919	
30	5.5675	4.1821	3.5894	3.2499	3.0265	2.8667	2.7460	2.6513	2.5746	
35	5.4848	4.1065	3.5166	3.1785	2.9557	2.7961	2.6755	2.5807	2.5039	
40	5.4239	4.0510	3.4633	3.1261	2.9037	2.7444	2.6238	2.5289	2.4519	
45	5.3773	4.0085	3.4224	3.0860	2.8640	2.7048	2.5842	2.4892	2.4122	
50	5.3403	3.9749	3.3902	3.0544	2.8327	2.6736	2.5530	2.4579	2.3808	
60	5.2856	3.9253	3.3425	3.0077	2.7863	2.6274	2.5068	2.4117	2.3344	
70	5.2470	3.8903	3.3090	2.9748	2.7537	2.5949	2.4743	2.3791	2.3017	
80	5.2184	3.8643	3.2841	2.9504	2.7295	2.5708	2.4502	2.3549	2.2775	
90	5.1962	3.8443	3.2649	2.9315	2.7109	2.5522	2.4316	2.3363	2.2588	
100	5.1786	3.8284	3.2496	2.9166	2.6961	2.5374	2.4168	2.3215	2.2439	
120	5.1523	3.8046	3.2269	2.8943	2.6740	2.5154	2.3948	2.2994	2.2217	



表4. F分配表(續3)

(ii)  $\alpha=0.05$

$$P(F_{m,n} \geq F_{m,n,\alpha}) = \alpha$$

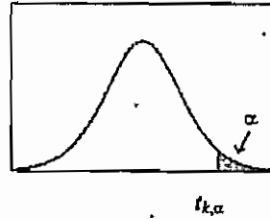


		分子自由度 m								
		1	2	3	4	5	6	7	8	9
分 母 自 由 度 n	1	161.448	199.500	215.707	224.583	230.162	233.986	236.768	238.883	240.543
	2	18.5128	19.0000	19.1643	19.2468	19.2964	19.3295	19.3532	19.3710	19.3848
	3	10.1280	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867	8.8452	8.8123
	4	7.7086	6.9443	6.5914	6.3882	6.2561	6.1631	6.0942	6.0410	5.9988
	5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759	4.8183	4.7725
	6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067	4.1468	4.0990
	7	5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257	3.6767
	8	5.3177	4.4590	4.0662	3.8379	3.6875	3.5806	3.5005	3.4381	3.3881
	9	5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789
	10	4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717	3.0204
	11	4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.9480	2.8962
	12	4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134	2.8486	2.7964
13	4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321	2.7669	2.7144	
14	4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987	2.6458	
15	4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408	2.5876	
16	4.4940	3.6337	3.2389	3.0069	2.8524	2.7413	2.6572	2.5911	2.5377	
17	4.4513	3.5915	3.1968	2.9647	2.8100	2.6987	2.6143	2.5480	2.4943	
18	4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767	2.5102	2.4563	
19	4.3807	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435	2.4768	2.4227	
20	4.3512	3.4928	3.0984	2.8661	2.7109	2.5990	2.5140	2.4471	2.3928	
21	4.3248	3.4668	3.0725	2.8401	2.6848	2.5727	2.4876	2.4205	2.3660	
22	4.3009	3.4434	3.0491	2.8167	2.6613	2.5491	2.4638	2.3965	2.3419	
23	4.2793	3.4221	3.0280	2.7955	2.6400	2.5277	2.4422	2.3748	2.3201	
24	4.2597	3.4028	3.0088	2.7763	2.6207	2.5082	2.4226	2.3551	2.3002	
25	4.2417	3.3852	2.9912	2.7587	2.6030	2.4904	2.4047	2.3371	2.2821	
26	4.2252	3.3690	2.9752	2.7426	2.5868	2.4741	2.3883	2.3205	2.2655	
27	4.2100	3.3541	2.9604	2.7278	2.5719	2.4591	2.3732	2.3053	2.2501	
28	4.1960	3.3404	2.9467	2.7141	2.5581	2.4453	2.3593	2.2913	2.2360	
29	4.1830	3.3277	2.9340	2.7014	2.5454	2.4324	2.3463	2.2783	2.2229	
30	4.1709	3.3158	2.9223	2.6896	2.5336	2.4205	2.3343	2.2662	2.2107	
35	4.1213	3.2674	2.8742	2.6415	2.4851	2.3718	2.2852	2.2167	2.1608	
40	4.0847	3.2317	2.8387	2.6060	2.4495	2.3359	2.2490	2.1802	2.1240	
45	4.0566	3.2043	2.8115	2.5787	2.4221	2.3083	2.2212	2.1521	2.0958	
50	4.0343	3.1826	2.7900	2.5572	2.4004	2.2864	2.1992	2.1299	2.0734	
60	4.0012	3.1504	2.7581	2.5252	2.3683	2.2541	2.1665	2.0970	2.0401	
70	3.9778	3.1277	2.7355	2.5027	2.3456	2.2312	2.1435	2.0737	2.0166	
80	3.9604	3.1108	2.7188	2.4859	2.3287	2.2142	2.1263	2.0564	1.9991	
90	3.9469	3.0977	2.7058	2.4729	2.3157	2.2011	2.1131	2.0430	1.9856	
100	3.9361	3.0873	2.6955	2.4626	2.3053	2.1906	2.1025	2.0323	1.9748	
120	3.9201	3.0718	2.6802	2.4472	2.2899	2.1750	2.0868	2.0164	1.9588	



表 3.  $t$  分配表

$$P(t_k \geq t_{k,\alpha}) = \alpha$$



自由度	單尾顯著水準						
	0.1	0.05	0.025	0.01	0.005	0.0025	0.001
1	3.0777	6.3138	12.7062	31.8205	63.6567	127.3213	318.3088
2	1.8856	2.9200	4.3027	6.9646	9.9248	14.0890	22.3271
3	1.6377	2.3534	3.1824	4.5407	5.8409	7.4533	10.2145
4	1.5332	2.1318	2.7764	3.7469	4.6041	5.5976	7.1732
5	1.4759	2.0150	2.5706	3.3649	4.0321	4.7733	5.8934
6	1.4398	1.9432	2.4469	3.1427	3.7074	4.3168	5.2076
7	1.4149	1.8946	2.3646	2.9980	3.4995	4.0293	4.7853
8	1.3968	1.8595	2.3060	2.8965	3.3554	3.8325	4.5008
9	1.3830	1.8331	2.2622	2.8214	3.2498	3.6897	4.2968
10	1.3722	1.8125	2.2281	2.7638	3.1693	3.5814	4.1437
11	1.3634	1.7959	2.2010	2.7181	3.1058	3.4966	4.0247
12	1.3562	1.7823	2.1788	2.6810	3.0545	3.4284	3.9296
13	1.3502	1.7709	2.1604	2.6503	3.0123	3.3725	3.8520
14	1.3450	1.7613	2.1448	2.6245	2.9768	3.3257	3.7874
15	1.3406	1.7531	2.1314	2.6025	2.9467	3.2860	3.7328
16	1.3368	1.7459	2.1199	2.5835	2.9208	3.2520	3.6862
17	1.3334	1.7396	2.1098	2.5669	2.8982	3.2224	3.6458
18	1.3304	1.7341	2.1009	2.5524	2.8784	3.1966	3.6105
19	1.3277	1.7291	2.0930	2.5395	2.8609	3.1737	3.5794
20	1.3253	1.7247	2.0860	2.5280	2.8453	3.1534	3.5518
21	1.3232	1.7207	2.0796	2.5176	2.8314	3.1352	3.5272
22	1.3212	1.7171	2.0739	2.5083	2.8188	3.1188	3.5050
23	1.3195	1.7139	2.0687	2.4999	2.8073	3.1040	3.4850
24	1.3178	1.7109	2.0639	2.4922	2.7969	3.0905	3.4668
25	1.3163	1.7081	2.0595	2.4851	2.7874	3.0782	3.4502
26	1.3150	1.7056	2.0555	2.4786	2.7787	3.0669	3.4350
27	1.3137	1.7033	2.0518	2.4727	2.7707	3.0565	3.4210
28	1.3125	1.7011	2.0484	2.4671	2.7633	3.0469	3.4082
29	1.3114	1.6991	2.0452	2.4620	2.7564	3.0380	3.3962
30	1.3104	1.6973	2.0423	2.4573	2.7500	3.0298	3.3852
35	1.3062	1.6896	2.0301	2.4377	2.7238	2.9960	3.3400
40	1.3031	1.6839	2.0211	2.4233	2.7045	2.9712	3.3069
45	1.3006	1.6794	2.0141	2.4121	2.6896	2.9521	3.2815
50	1.2987	1.6759	2.0086	2.4033	2.6778	2.9370	3.2614
60	1.2958	1.6706	2.0003	2.3901	2.6603	2.9146	3.2317
70	1.2938	1.6669	1.9944	2.3808	2.6479	2.8987	3.2108
80	1.2922	1.6641	1.9901	2.3739	2.6387	2.8870	3.1953
90	1.2910	1.6620	1.9867	2.3685	2.6316	2.8779	3.1833
100	1.2901	1.6602	1.9840	2.3642	2.6259	2.8707	3.1737
200	1.2858	1.6525	1.9719	2.3451	2.6006	2.8385	3.1315
300	1.2844	1.6499	1.9679	2.3388	2.5923	2.8279	3.1176
400	1.2837	1.6487	1.9659	2.3357	2.5882	2.8227	3.1107
500	1.2832	1.6479	1.9647	2.3338	2.5857	2.8195	3.1066
600	1.2830	1.6474	1.9639	2.3326	2.5840	2.8175	3.1039
700	1.2828	1.6470	1.9634	2.3317	2.5829	2.8160	3.1019
800	1.2826	1.6468	1.9629	2.3310	2.5820	2.8148	3.1005
900	1.2825	1.6465	1.9626	2.3305	2.5813	2.8140	3.0993
1000	1.2824	1.6464	1.9623	2.3301	2.5808	2.8133	3.0984



Part A. Choose the correct answer for each of following questions. ( 10 points for each question).

1. The only possible dimensionless group that combines velocity  $V$ , body size  $L$ , fluid density  $\rho$ , and surface tension coefficient  $\sigma$  is

- (a)  $L\rho\sigma/V$  (b)  $\rho VL^2/\sigma$  (c)  $\rho\sigma V^2/L$  (d)  $\sigma LV^2/\rho$  (e)  $\rho LV^2/\sigma$

2. On a sea-level standard day, a pressure gage, moored below the surface of the ocean (SG = 1.025), reads an absolute pressure of 1.4 MPa. How deep is the instrument?

- (a) 4m, (b) 129m, (c) 133m, (d) 140m, (e) 2080m

3. A floating body will be stable when its

- (a) center of gravity is above its center of buoyancy, (b) center of buoyancy is below the waterline, (c) center of buoyancy is above its metacenter, (d) metacenter is above its center of buoyancy, (e) metacenter is above its center of gravity

4. Given the steady velocity distribution  $V = 3xi + 0j + Cyk$ , where  $C$  is a constant, if the flow is irrotational, the value of  $C$  should be

- (a) 3, (b) 3/2, (c) 0, (d) -3/2, (e) -3

5. If a stream flowing at velocity  $U$  past a body of length  $L$  causes a force  $F$  on the body that depends only on  $U$ ,  $L$ , and fluid viscosity  $\mu$ , then  $F$  must be proportional to

- (a)  $\rho UL/\mu$ , (b)  $\rho U^2 L^2$ , (c)  $\mu U/L$ , (d)  $\mu UL$ , (e)  $UL/\mu$





## Part B.

1. (20%) Please define the following terms:

- (1) Steady flow
- (2) Uniform flow
- (3) Laminar flow
- (4) Equation of Continuity
- (5) Velocity head
- (6) Bulk modulus of elasticity
- (7) Velocity gradient
- (8) Equivalent pipes
- (9) Pitot tube
- (10) Viscosity of a fluid

2. (10%) The Reynolds number is a function of density, viscosity, and velocity of a fluid, and a characteristic length. Please establish the Reynolds number relation by dimensional analysis.

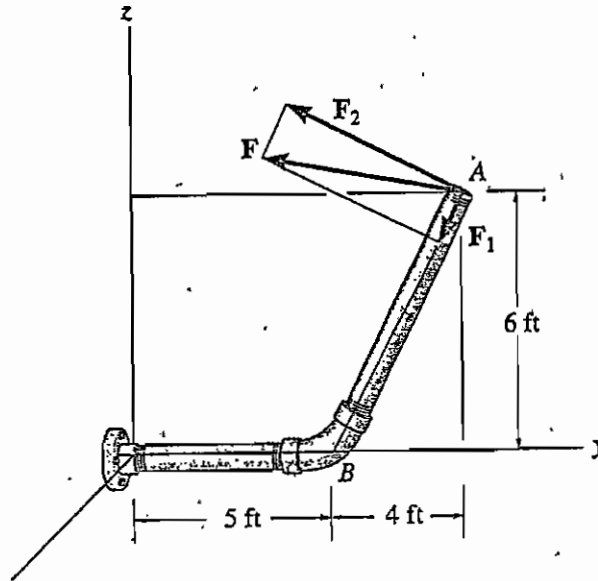
3. (10%) For steady, incompressible flow, are the following values of  $u$  and  $v$  possible?

$$(1) u = 4xy + y^2, v = 6xy + 3x \quad (2) u = 2x^2 + y^2, v = -4xy$$

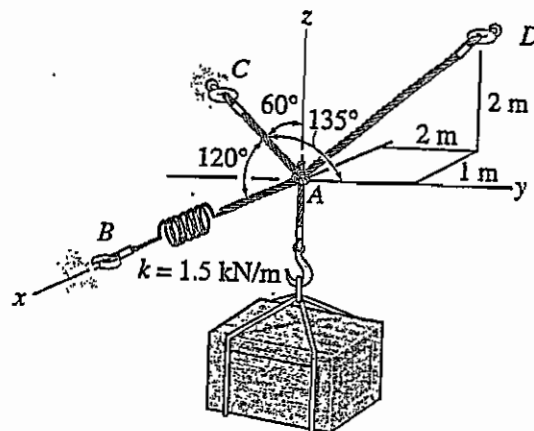
4. (10%) Develop the expression for critical depth, critical specific energy and critical velocity (1) for rectangular channels and (2) for a channel.



- 一、力  $F = \{25i - 50j + 10k\}$  N 作用在組合管的端點 A，試求平行與垂直於 AB 軸的兩個分量  $F_1$  與  $F_2$ 。(25 分)



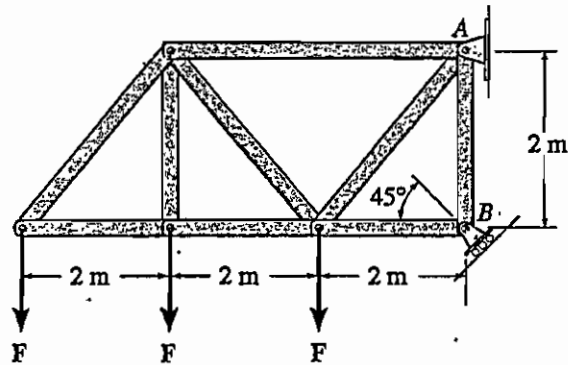
- 二、100 公斤的木箱由三條繩索所支撐，其中一條與彈簧相連接。試求繩索 AC 與 AD 之張力及彈簧的伸長度。(25 分)



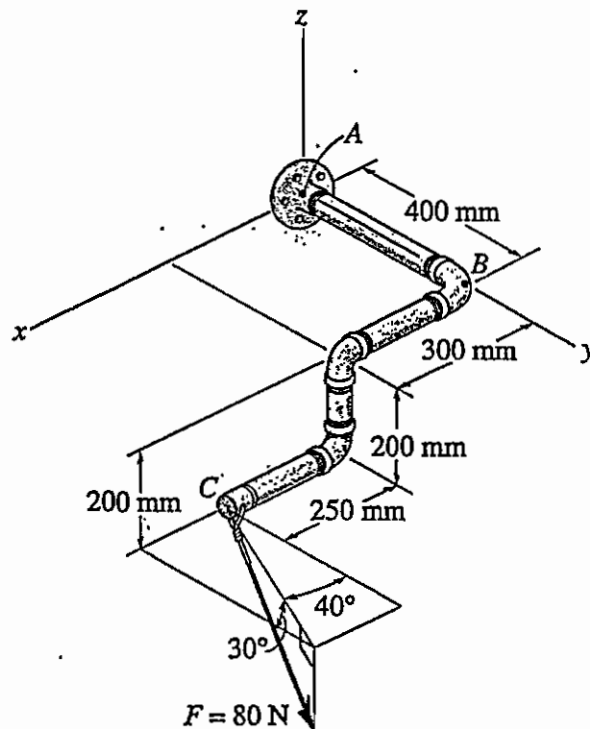


三、試求銷(pin)A 之反作用力的水平與垂直分量，及滾子 B 之反作用力。假設力  $F = 600 \text{ N}$ 。(25 分)

(提示： $\sin 45^\circ = 0.707$ ,  $\cos 45^\circ = 0.707$ )



四、圖中水管配組件受到  $80 \text{ N}$  力量作用，試求此作用力對 B 點的力矩。(25 分)  
(提示： $\sin 30^\circ = 0.5$ ,  $\cos 30^\circ = 0.866$ ,  $\sin 40^\circ = 0.643$ ,  $\cos 40^\circ = 0.766$ )

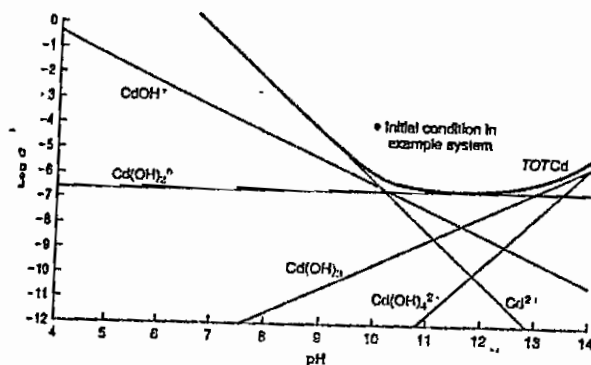




一、請選擇一個最適當之答案，答對一題 3 或 4 分，答錯一題倒扣 1 分。(45%)

- The major domains of all organisms DID NOT include: (3%)  
 (1) Bacteria, (2) Archaea, (3) Prokaryotes, (4) Eukarya
- The substance which contains water and the macromolecules that the cell need to function: (3%) (1) enzyme, (2) cytoplasm, (3) chromosome, (4) Mitochondrion
- Which one of the followings IS NOT Protozoa? (3%)  
 (1) Cyanophyta, (2) Ciliates, (3) Amoeba, (4) Flagellates.
- What kind of reaction yields the lowest amount of energy? (3%)  
 (1) fermentation, (2) aerobic reaction, (3) nitrification, (4) photosynthesis.
- Regarding to enzyme-catalyzed reactions, which one is WRONG? (3%)  
 (1) Michaelis-Menton equation describes it well,  
 (2) The rate changes from first-order to zero order as substrate concentrations increase,  
 (3) A lower value of the coefficient  $K_M$  means poor affinity of enzyme to substrate,  
 (4) The reactions depend upon pH and temperature.
- $\text{HOCl} + \text{NH}_3 \rightleftharpoons \text{NH}_4^+ + \text{OCl}^-$  is a reaction of: (3%)  
 (1) oxidation-reduction, (2) acid-base, (3) complex formation, (4) dissolution.
- A set of reaction data has a positive slope  $K$  in  $1/\text{Concentration}$  versus Time plot. The reaction could be: (3%) (1) zero order, (2) first-order, (3) second-order, (4) pseudo-first order.
- The half-life of one chemical is 5 days. A 99% reduction would need ? days.  
 ( $\ln 2 = 0.693$ ,  $\ln 0.01 = -4.605$ ) (4%) (1) 0.64, (2) 6.65, (3) 20, (4) 33.2.
- The equation of  $\text{NO}_3^- + \text{SO}_3^- + \text{H}^+ \rightleftharpoons \text{N}_2 + \text{SO}_4^{2-} + \text{H}_2\text{O}$  with the stoichiometric coefficients of: (4%)  
 (1) 2, 5, 2, 1, 5, 1 (2) 2, 5, 1, 1, 5, 1 (3) 4, 10, 2, 4, 10, 1 (4) 4, 10, 2, 4, 10, 2.

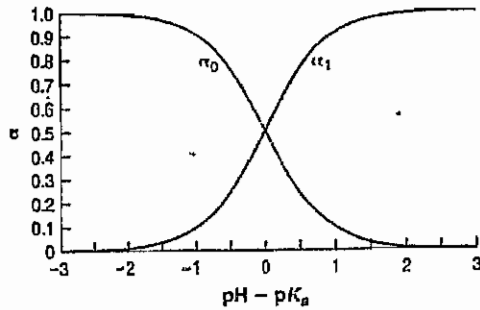
10.



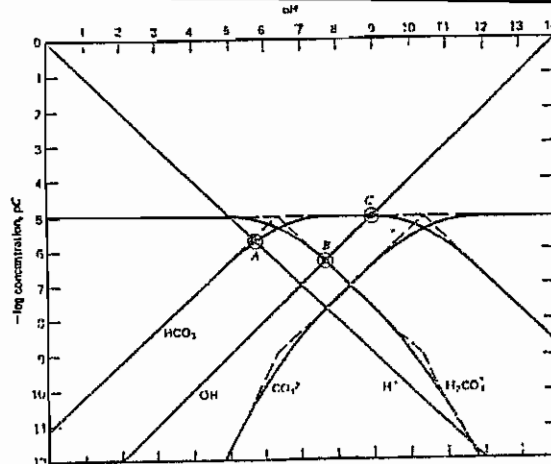
What are the major complex components at pH 11? (4%) (1)  $\text{Cd}^{+2}$ ,  $\text{CdOH}^+$ ,  
 (2)  $\text{CdOH}^+$ ,  $\text{Cd(OH)}_3^+$ , (3)  $\text{Cd(OH)}_2^0$ ,  $\text{Cd(OH)}_3^+$ , (4)  $\text{CdOH}^+$ ,  $\text{Cd(OH)}_2^0$ .



11.



Plot (a)

Fig 4-17. The pC-pH diagram for a  $10^{-5}$  M carbonate solution at 25 C.

Plot (b)

Using above Plot (a) to determine the component of  $[\text{CH}_3\text{COOH}]$  and  $[\text{CH}_3\text{COO}^-]$  at total concentration of 1M and pH 5.2 ( $\text{pK}_a=4.7$ )? (4 %)

(1) 0.03 and 0.97, (2) 0.1 and 0.9, (3) 0.24, 0.76, (4) 0.5 and 0.5.

12. Using the above Plot (b) to solve the closed carbon systems, the proton condition and

pH of  $10^{-5}$  M  $\text{NaHCO}_3$  are ? (4 %) (1)  $[\text{H}^+] = [\text{OH}^-] + [\text{HCO}_3^-] + 2[\text{CO}_3^{2-}]$  and 5.7,

(2)  $[\text{H}^+] = [\text{OH}^-]$  and 7.0, (3)  $[\text{H}^+] + [\text{H}_2\text{CO}_3^*] = [\text{OH}^-] + 2[\text{CO}_3^{2-}]$  and 7.6,

(4)  $[\text{H}^+] + 2[\text{H}_2\text{CO}_3^*] + [\text{HCO}_3^-] = [\text{OH}^-]$  and 9.0.

13.  $\text{Ca}^{+2} + \text{EDTA}^{-4} \rightleftharpoons (\text{EDTA-Ca})^{-2} \quad K=10^{+10.7}$

$\text{Mg}^{+2} + \text{EDTA}^{-4} \rightleftharpoons (\text{EDTA-Mg})^{-2} \quad K=10^{+8.7}$

$\text{Mg}^{+2} + \text{EBT} \rightleftharpoons (\text{EBT-Mg})^{-2} + 2\text{H}^+ \quad K=10^{+7}$

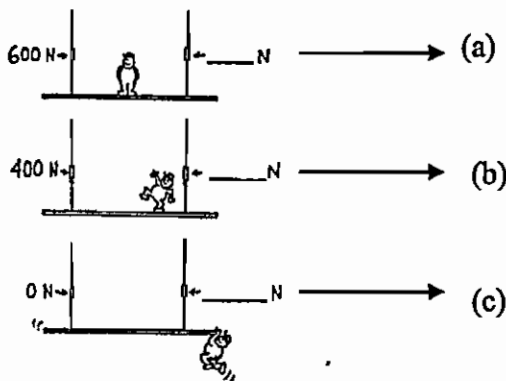
In determine the total hardness, what solution is added and what chemical gives the final color? (4 %) (1)  $(\text{EBT-Mg})^{-2}$ , EBT, (2)  $\text{EDTA}^{-4}$ ,  $(\text{EDTA-Ca})^{-2}$ , (3)  $\text{EDTA}^{-4}$ ,  $(\text{EDTA-Mg})^{-2}$ , (4)  $\text{EDTA}^{-4}$ , EBT.

## 二、問答及計算題 (55%)

- 試述革蘭式陽性菌與陰性菌在細胞組成上之主要差異。(5%)
- 試說明微生物如何以碳源及能量來源(carbon and energy source)來進行分類。(10%)
- 假如擬採用生物處理方法去除污水中之氮，試說明可採用何種之去除程序，另所進行之反應及其參與之微生物種類為何。(10%)
- 試說明下水道管渠管頂腐蝕發生之原因及其參與反應之相關微生物種類。(10%)
- 某排放源排放體積比為 1% 之一氧化碳，假如其溫度為  $80^\circ\text{C}$ ，試以 ppm 及  $\mu\text{g}/\text{m}^3$  表示其濃度。(10%)
- (a) 何謂自由有效氯、結合有效氯、折點加氯法。(5%)  
(b) 採用加氯消毒時，試解釋說明 pH 值如何影響消毒之效率。(5%)



- (2%) 假定我們以兩手各自抓住紙巾的兩端並用力向兩端緩慢撕扯，或是將裝有物品的塑膠袋以兩手同時分持袋口處兩側，並使之在兩手中間快速的旋轉，而後向兩端[反方向]拉，請問：為何快速的拉扯比緩慢的拉更易造成破裂的結果？
- (3%) 玻璃圍幕大樓外強的清潔工人，依下圖方式分別站在(a)梯版的中央，(b)右邊，以及(c)懸吊在梯版一側。請就其右側繩索應承受之重量為何？



- (5%) 假如一個男人以雙手很沉穩地抓住一把來福槍，並扣下板機；然後，我們將其描述為「子彈的動量等於後座力」。請問：如果要使這個說法成立，則其「前提」為何？
- (5%) Now consider the same two blobs located on opposite sides of the Earth.
  - ( ) a. Because of differences in the moon's pull on the blobs, they tend to : ① spread away from each other ; ② approach each other .
  - ( ) b. Does this spreading produce ocean tides? ① Yes ; ② No .
  - ( ) c. If Earth and moon were closer, gravitational force between them would be : ① more ; ② the same ; ③ less ;
  - ( ) d. and the difference in gravitational forces on the near and far parts of the ocean would be : ① more ; ② the same ; ③ less .



- ( ) e. Because the Earth's orbit about the sun is slightly elliptical, Earth and sun are closer in December than in June. Taking the sun's tidal force into account, on a world average, ocean tides are greater in : ① December ; ② June ; ③ no difference .
- 5.( ) (2%) Which law that we can use to explain the phenomenon of collision ? ① conservational of momentum ; ② Newton's first law ; ③ action force ; ④ Rotational inertia .
- 6.( ) (2%) Rotational acceleration is the rate of change in rotational velocity. What is wrong below ? ① the unit is  $\text{rev/s}^2$  ; ② the unit is  $\text{rad/s}^2$  ; ③  $\Delta\omega = at$  ; ④  $\Delta\omega = dt$  .
- 7.( ) (2%) What term we call of the applied force that is the perpendicular distance from the axis of rotation to the line of action in the lever arm ? ① torque ; ② work ; ③ action force ; ④ potential energy .
- 8.( ) (2%) If the gravity between sun and earth is disappear in one day, then we will found—the earth will obey which law : ① law of conservation of momentum ; ② law of conservation of energy ; ③ law of inertia ; ④ law of revolution .
- 9.( ) (2%) How many times of distance that we need , when a car traveling at 60MPH as for one traveling at 20MPH, in stopping the car ? ① 4 ; ② 9 ; ③ 16 ; ④ 25 .
10. (4%) Microwaves, such as those used for radar and to heat food in a microwave oven, have wavelengths greater than about  $3 \text{ mm}$ . What is the frequency of radiation of wavelength  $4.15 \text{ mm}$ ?
11. (8%) How many electrons can have the following quantum numbers in an atom: (a)  $n = 2, l = 1$ ; (b)  $n = 4, l = 2, m_l = -2$ ; (c)  $n = 2$ ; (d)  $n = 3, l = 2, m_l = +1$  ?
12. (8%) Under what conditions would you expect a real gas to be (a) more compressible than an ideal gas; (b) less compressible than an ideal gas?
13. (5%) Explain why ionic solid such as NaCl have high melting points yet dissolve readily in water, whereas network solids such as diamond have very high melting points and do not dissolve in solvents.



14. (10%) Perform the following mathematical operations, and express the result to the correct number of significant figures.
- a.  $6.022 \times 10^{23} \times 1.05 \times 10^2$     b.  $\frac{6.6262 \times 10^{-34} \times 2.998 \times 10^8}{2.54 \times 10^{-9}}$
15. (10%) A 10 mL sample of vinegar, an aqueous solution of acetic acid ( $\text{HC}_2\text{H}_3\text{O}_2$ ), is titrated with 0.5062 M NaOH, and 16.58 mL is required to reach the equivalence point,
- a. What is the molarity of the acetic acid?  
b. If the density of the vinegar is  $1.006 \text{ g/cm}^3$ , what is the mass percent of acetic acid in the vinegar?
16. (10%) One mole of  $\text{H}_2\text{O}(\text{g})$  at 1.00 atm and  $100.^\circ\text{C}$  occupies a volume of 30.6 L. When one mole of  $\text{H}_2\text{O}(\text{g})$  is condensed to one mole of  $\text{H}_2\text{O}(\text{l})$  at 1.00 atm and  $100.^\circ\text{C}$ , 40.66 kJ of heat is released. If the density of  $\text{H}_2\text{O}(\text{l})$  at this temperature and pressure is  $0.996 \text{ g/cm}^3$ , calculate  $\Delta E$  for the condensation of one mole of water at 1.00 atm and  $100.^\circ\text{C}$ . (1 L-atm = 101.3 J)
17. (10 %) Nickel has a face-centered cubic unit cell. The density of nickel is  $6.84 \text{ g/cm}^3$ . Calculate a value for the atomic radius of nickel. (Ni=58.69 g/mol)
18. (10%) The enthalpy of vaporization of mercury is  $59.1 \text{ kJ/mol}$ . The normal boiling point of mercury is  $372.^\circ\text{C}$ . What is the vapor pressure of mercury at  $25.^\circ\text{C}$ ? ( $R=8.3145 \text{ J/K-mol}$ )