國立中山大學九十學年度碩博士班招生考試試題

科目：普通生物【海資系碩士班】甲組

1. What is the difference between Protostomes and Deuterostomes? 10%

2. What are the components of a photosystem? How do they each contribute to the transformation of light energy to chemical energy? 10%

3. What are the various types of connective tissue? What types of cells characterize each, and how does the cellular structure relate to the tissue function? 15%

4. What is symbiosis? How can you distinguish between the different forms of this interspecific interaction? How has natural selection and coevolution influenced symbiotic relationships? 15%

5. 詳述動物生殖的演化.25%

6. 詳述生物如何將環境的訊息轉換為生物的訊息,並如何將訊息在體內傳遞.25%

國立中山大學九十學年度碩博士班招生考試試題

科目：生物化學【海資系碩士班】甲組選考

1. (5%) What is the "post-genome era"? What are the major tasks in the post genome era?

2. (15%) Please describe briefly the meanings of the following terms in biochemistry:
   (a) electron transfer system and its example;
   (b) operon and its example;
   (c) restriction enzyme and its example;
   (d) phosphorylase and its example;
   (e) receptor and its example;

3. (10%) Please describe a metabolic pathway. What is the relationship between the pathway and its operon in prokaryotic cells?

4. (10%) Please describe a protocol to assay glucose using either instrument or enzymology.

5. (10%) Describe a method to purify DNA from cells.

6. (20%) List ten amino acids including their structure and properties.

7. (10%) There is an *E. coli* plasmid pDA14 containing a virus coat protein. To make sure the construction is right, you are requested to map it by *Eco*RI, *Xba*I, and *Pst*I. The fragment of *Eco*RI in agarose gel is 4.76kb. There is a single cut for *Xba*I. Two pieces of DNA are obtained with *Pst*I digestion, in which one piece is 430bp. After multiple digestion of *Eco*RI and *Pst*I, three pieces are observed, among which there is a fragment of 948bp. Multiple digestion of *Xba*I and *Pst*I, three fragments are obtained and one of them is 1.08kb. Please draw the map of the plasmid with the correct positions of *Eco*RI, *Xba*I, and *Pst*I.

8. (5%) The size of a viral coat protein gene in pDA14 is 987 nucleotides. What is the size of its encoding protein in SDS-PAGE you expect to see?

9. (15%) Tris buffer has been used in several enzyme reactions. Please describe very detail about how to prepare a 10mM Tris (pH8.0) buffer. The commercial Tris is a powder with its molecular weight of 121.14g.

國立中山大學九十學年度碩博士班招生考試試題

科目：生理學【海資系碩士班】甲組選考

1. 人體如何保持恆溫.(30%)

2. 繪圖詳述 chemical synapse 及 electrical synapse(30%),並說明其優缺點(10%)

3. 人體如何保持滲透壓的平衡.(30%)

國立中山大學九十學年度碩博士班招生考試試題

科目：生態學【海資系碩士班】乙組

一. 選擇題 (30%) (單選，每題2分，答錯倒扣1分)

( ) 1. 一般所謂酸雨(Acid rain)乃指PH小於 A)8.7 B)7.0 C)6.3 D)5.7 E)4.3 的雨水

( ) 2. "藤壺著生在鯨魚體上" 之關係是屬於 A)Mutualism B)Commensalism C)Parasitism D)Competition E)Cooperation

( ) 3. 在生態系發展的過程中，當生物群聚之生產量(Production) 和呼吸量(Respiration) 比值約等於1時是屬於哪個階段 A)Seral Stage B)pioneer Stage C)Climax D)Aging Stage E)Cline

( ) 4. 有關生態系物質的循環理論，下列何種狀況之循環指數(Cycling index) 值會大於10%以上 A)生態系發展初期 B)當資源很多時 C)對於非必要元素而言 D)在寒冷的湖泊中 E)以上皆非

( ) 5. 根據Mac Arthur 所提之島嶼生物地理平衡說，物種遷入率最低的通常是 A)離大陸較近的大島 B)離大陸較近的小島 C)離大陸較遠的大島 D)離大陸較遠的小島 E)以上皆非

( ) 6. 假設台灣西南海域主要之生態食物鏈是由浮游植物→浮游動物→小魚→大魚所組成，經調查研究結果發現此海域之浮游植物整年的生產量為10^7 cals，假設平均的生態轉換效率為10%，請問此海域之大魚生產量大概為多少？ A)10^6 cals B)10^5 cals C)10^4 cals D)10^3 cals E)10^2 cals

( ) 7. 經常造成海域赤潮 (Red tide) 的是哪一類之海洋生物？ A)Diatoms B)Dinoflagellates C)Coccolithophorids D)Cyanophytes E)Copepods

( ) 8. 蝴蝶的生存曲線是屬於 A)Convex curve B)Straight line C)Concave curve D)Slight sigmoid type curve E)Stairstep type curve

( ) 9. 下列何者會隨著生物群聚發展的趨勢而逐漸減低 A)Turnover time B)Mutualistic symbiosis C)Resilience stability D)Nutrient conservation E)The efficiency of energy & nutrient utilization

( ) 10. 在生態系物質的循環中， A)Carbon B)Nitrogen C)Phasphate D)H_2O E)SO_2 是屬於沈積性的循環(Sedimentary cycles)

( ) 11. 根據生態熱力學的觀念，下列何者之熵(Entropy)值最高 A)ATP B)ADP C)AMP D)ATP,ADP,AMP 三者都一樣 E)不一定

( ) 12. 目前國內共設置了 A)4 B)5 C)6 D)7 E)8 個國家公園

( ) 13. 下列哪種森林生態系之營養循環最趨向於"物理化" A)Tropical rain forest B)Tropical gallery forest C)Temperate deciduous forests D)Boreal forests E)Temperate evergreen forests

( ) 14. 在生態系具有固氮作用的物種是A)根瘤菌 B)珊瑚共生藻 C)地衣 D)矽藻 E)雙鞭毛藻

( ) 15. 請問下表(Life table)第三年的平均生命期望值(e_3)是多少？ A)1.58 B)1.97 C)1.12 D)2.35 E)2.18

Life table for the Barnacle Balanus glandula at the upper shore level on pile point, San Jan island, Washington.

Age(yr) (x)	0	1	2	3	4	5	6	7	8	9
Observed No. Barnacles alive each year (n_x)	142	62	34	20	15.5	11	6.5	2	2	0
:										
Mean expectation of further life for animals alive at start of age x (e_x)	e_0	e_1	e_2	e_3	e_4	e_5	e_6	e_7	e_8	e_9

二. 解釋名詞(18%) (每題3分)

1. Sibling species
2. Poikilothermic species
3. Bioturbulence
4. Character displacement
5. Krill
6. Minimum viable population

三. 簡答題 (12%) (**答題請勿超過30個字，多一字扣1分**)

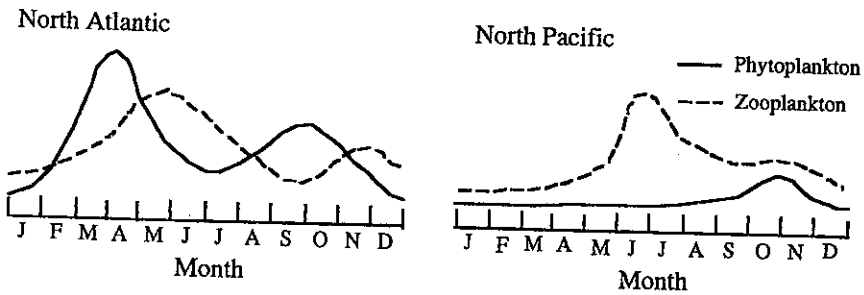
1. 要建立一個好的生態模式(Ecological model)必須具備哪三個要件？(3分)
2. 生物多樣性(Biodiversity)基本上可分為哪三種型式來探討？(3分)
3. 國內最早設置的是哪一座國家公園？最晚設置的是哪一座國家公園？(2分)
4. Liebig's Law of the Minimum之先決條件為何？(2分)
5. 請列舉兩個台灣近一年來所發生之重大生態或環保事件？(2分)

四. 問答題 (40%) (每題10分)

1. 請詳述三個物種起源的假說(Three hypothesis of speciation)？
2. 請繪圖並簡單說明生態能流模式(Model of ecological energy flow)？

3. 請敘述“聖嬰現象(El Niño)“之形成機制為何？其對於全球環境生態有何影響？

4. 下面兩個圖為浮游生物群聚生物量在不同海域之季節變化示意圖，請敘述結果並說明可能原因？



國立中山大學九十學年度碩博士班招生考試試題

科目：生物統計學【海資系碩士班】乙組

(20%) 1. 有一魚苗養殖場養成的魚苗平均體長為 3.1 公分，標準差為 0.1 公分，假設魚苗體長為常態分布。今某甲做實驗，所需魚苗規格為 3.0 ± 0.2 公分，想向此養殖場購買，請問此養殖場所供應之魚苗不符某甲所需之比例為多少？

(30%) 2. 下表取材自 Limnology and Oceanography 期刊 2001 年 46 期 281 頁之資料，由此表請問你（妳）可以經由那些統計運算得到何種結論？（請列出各統計運算過程，結果及結論）

Table 1. Release rate coefficient (d^{-1}) of metals and C in the decomposing phytoplankton debris (diatom *Thalassiosira pseudonana*, and dinoflagellate *Prorocentrum minimum*). Mean ± SD (n = 2).

Treatment	Cd	Cr	Se	Zn	C
T. pseudonana					
With bacteria	1.68 ± 0.16	0.147 ± 0.042	0.712 ± 0.001	0.765 ± 0.048	0.443 ± 0.012
With NaN_3	0.765 ± 0.011	0.092 ± 0.014	0.925 ± 0.018	0.339 ± 0.021	0.373 ± 0.018
P. minimum					
With bacteria	1.67 ± 0.01	0.239 ± 0.052	0.845 ± 0.032	1.14 ± 0.05	0.512 ± 0.024
With NaN_3	0.491 ± 0.008	0.113 ± 0.002	0.492 ± 0.007	0.297 ± 0.007	0.275 ± 0.004

3. 某人栽培大豆，每週生長高度（公分）如下：

週數（X）	1	2	3	4	5	6	7
高度（Y）	4	12	16	24	35	40	42

$\Sigma X_i=28$　　$\Sigma Y_i=173$　　$\Sigma X_iY_i=881$　　$\Sigma X_i^2=140$　　$\Sigma Y_i^2=5581$

(10%) (a) 利用以上提供之數據，以最小平方法(Least square method)求迴歸直線（請一併列出計算公式及計算過程）

(10%) (b) 請解釋迴歸方程式中，截距與迴歸係數在生物學上的意義

(10%) (c) 請檢定迴歸係數是否為 0 (α=0.05)

(5%) (d) 求兩變數間的決定係數(coefficient of determination)，並解釋此數據所代表的意義。

(5%) (e) 求兩變數間的相關係數（correlation coefficient）

(10%) (f) 請說明此相關係數之意義，及其與直線迴歸方程式所得結果，二者所提供之訊息有何異同？

國立中山大學九十學年度碩博士班招生考試試題

科目：生物統計學【海資系碩士班】乙組

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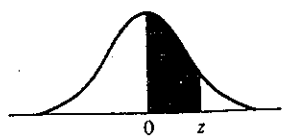
附表 1

Table 1 Normal curve areas

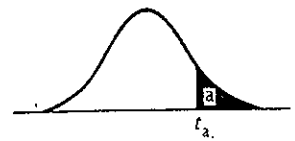


z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

This table is abridged from Table I of *Statistical Tables and Formulas*, by A. Hald (New York: John Wiley & Sons, 1952). Reproduced by permission of A. Hald and the publishers, John Wiley & Sons.

附表 2

Table 2 Percentage points of the *t* distribution



df	a = .10	a = .05	a = .025	a = .010	a = .005
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
inf.	1.282	1.645	1.960	2.326	2.576

From "Table of Percentage Points of the *t*-distribution." Computed by Maxine Merrington, *Biometrika*, Vol. 32 (1941), p. 300. Reproduced by permission of the *Biometrika* Trustees.

國立中山大學九十學年度碩博士班招生考試試題

科目：生物統計學【海資系碩士班】乙組

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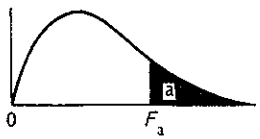
附表3

Table 4 Percentage points of the F distribution



Degrees of freedom ($a = .05$)

df_2 \ df_1	1	2	3	4	5	6	7	8	9
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88

df_2 \ df_1	10	12	15	20	24	30	40	60	120	∞
1	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

From "Tables of Percentage Points of the Inverted Beta (F)-Distribution," *Biometrika*, Vol. 33 (1943), pp. 73–88, by Maxine Merrington and Catherine M. Thompson. Reproduced by permission of the *Biometrika* Trustees.

國立中山大學九十學年度碩博士班招生考試試題

科目：礦物學【海資系碩士班】丙組選考

1. 三維晶格共有 14 種，稱為 14 種布拉維晶格，請問：
   （a）請問等軸（isometric）晶系和正方（tetragonal）晶系中各有那幾種布拉維晶格，並繪圖表示。
   （b）那一種晶格是等軸晶系中有而正方晶系中沒有？為什麼？（繪圖討論）（15%）
2. 何謂點群（point group）？如何決定礦物的點群對稱？（8%）
3. 試利用簡繪之赤平投影圖（stereoprojection）及假設之晶面極（face pole，取 general form 之晶面）作以下點群之對稱運作，找出並投繪出其他晶面極，並指出該點群所屬晶系和所產生之晶形名稱（crystal system and crystal form）(20%)
   （a）旋逆對稱 $\bar{3}$
   （b）旋射對稱 $\tilde{3}$
   （c）2/m 2/m 2/m
   （d）m
4. 試說明下列 Hermann-Maugin 符號之意義（符號代表什麼意義？有什麼性質？在空間中相對於晶體座標系統的關係為何？可繪圖輔助說明）（10%）
   （a）I 432
   （b）$P\,2_12_12_1$
5. 有一橄欖石（olivine）晶體，已知其化學成份為 MgO = 56.17 %, FeO = 2.05 %, SiO_2= 41.85 %（重量百分比），試計算此橄欖石之化學式（需寫出計算過程，原子量 O = 16, Mg = 24.3, Fe = 55.8, Si = 28）（10%）
6. （a）試述礦物的定義。
   （b）礦物依化學成份可分為那幾大類？
   （c）其中那一大類礦物在地殼最為常見？（10%）
7. 試敘述研究礦物學有什麼意義和重要性。（10%）
8. 試列舉五種礦物，寫出它們的化學式或主要化學成份，並說明它們的經濟用途。（10%）
9. 常用來量測礦物密度的方法有那幾種？簡單說明之。（7%）

國立中山大學九十學年度碩博士班招生考試試題

科目：流體力學【海資系碩士班】丙組選考

一、解釋名詞(每題 7 分)

1. continuity equation
2. incompressible flow
3. vorticity
4. Reynolds number
5. Froude number
6. cavitation
7. boundary layer
8. local and convective acceleration
9. Bernoulli equation
10. head loss

二、一浸 於流體中的物體所受之力 F 隨著下列參數而改變:物體長度 L，流體密度 ρ，流體黏滯係數 μ，流動速度 V，亦即 $F = f(L, V, \rho, \mu)$，利用無因次分析方法將其無因次化。(10 分)

三、下列速度場何者爲無旋性流動(irrotational flow),

(a) $V = 2xy\vec{i} + (x^2 - y^2)\vec{j}$

(b) $V = -(2xy + x)\vec{i} + (y^2 + y - x^2)\vec{j}$

並求出無旋流動之速度位(velocity potential)和流函數(stream function). (10 分)

四、A venturi meter, shown in Fig. P3.165, is a carefully designed constriction whose pressure difference is a measure of the flow rate in a pipe. Using Bernoulli equation for steady incompressible flow with no losses, show that the flow rate Q is related to the manometer reading h by

$$Q = \frac{A_2}{\sqrt{1 - (D_2 / D_1)^4}} \sqrt{\frac{2gh(\rho_M - \rho)}{\rho}}$$

Where ρ_M is the density of the manometer fluid. (10 分)

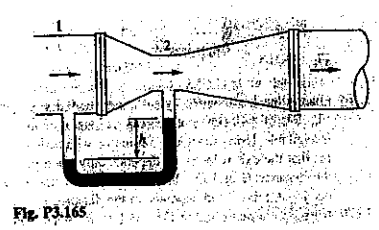


Fig. P3.165

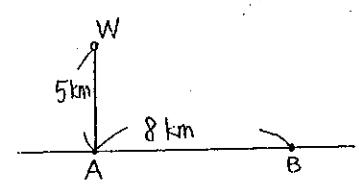
國立中山大學九十學年度碩博士班招生考試試題

科目：微積分【海資系碩士班】丙組選考

1. 試求半徑為 a 之半圓的形心 (center of mass)。
2. 試討論曲線 $y=\dfrac{x}{x^2-1}$ 之升降與凹凸情形，並繪其簡圖。
3. 求函數 $f(x,y)=x^2-2xy+y^2-y^3$ 在 $[-\frac{1}{2},1]\times[-\frac{1}{2},1]$ 之 最大值與最小值。
4. 試求積分 $\displaystyle\int_{-1}^{1}\int_{y^2}^{1} e^{\sqrt{x}}dx$ 之值。
5. 判定下列級數為收斂或發散(請詳述理由)。

   (a) $\displaystyle\sum_{n=1}^{\infty}\frac{1}{n}$　　(b) $\displaystyle\sum_{n=1}^{\infty}\frac{\ln n}{n^2}$

6. 若 C 表橢圓 $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}=1$，試求線積分 $\displaystyle\oint_C \frac{-ydx+xdy}{x^2+y^2}$ 之值。
7. 假設有一油井座落於海底 W 點(見下圖)，此 W 點距離海岸之最近點 A 為 5 km ，現欲抽取石油到岸上的 B 點，已知 A, B 之距離為 8 km，以及在海底埋油管的費用是每公里十萬元，在陸地上埋油管的費用是每公里五千元 ，問應如何埋設油管，可使得埋設油管之成本為最低。



8. 試求曲線 $y=\dfrac{1}{2}(e^x+e^{-x}),\ 0\le x\le \ln 2$, 繞 x 軸旋轉所形成之曲面的表面積。
9. 設 D 為 $x^2+y^2+z^2=1$ 與 $x^2+y^2+z^2=4$ 兩球面之間的區域，試求積分 $\displaystyle\iiint_D \frac{z^2dxdydz}{\sqrt{x^2+y^2+z^2}}$
10. 試解微分方程 $\dfrac{dy}{dx}=xy^2-x$。

（每題十分，總分一百分）

國立中山大學九十學年度碩博士班招生考試試題

科目：普通地質學【海資系碩士班】丙組選考

一、 解釋名詞（每小題 3 分，共 30 分）

1. asthenosphere
2. Cenozoic Era
3. chemical weathering
4. dike
5. Bowen's reaction series
6. hydrothermal metamorphism
7. principle of superposition
8. thrust fault
9. karst
10. alluvial fan

二、 簡答題（每小題 7 分，共 70 分）

1. 試簡單說明一個科學假說（scientific hypothesis）、科學理論（scientific theory）和科學定律（scientific law）之間的差異在那裡？
2. 為什麼石英（quartz）沒有明顯的解理（cleavage）？石英（或水晶）雖然可以是很漂亮的礦物，為什麼它不是一種昂貴的寶石礦物？
3. 試列舉常見的火成岩，並依岩石所具有的特性作簡單之分類。
4. 地球的半徑有 6400 公里，但人類目前只能鑽探達到 10 公里深（陸地上）和 2 公里深（海床下），試問我們還有那些方法可以用來研究和瞭解地球內部的構造和性質？
5. 地質作用可分為外營力與內營力的地質作用（processes of external vs, internal origin），試說明外營力和內營力之最終能量來源為何？並分別舉出外營力和內營力所造成之地質作用的例子。
6. 造成台灣九二一大地震的斷層是那一條？其屬於何種型式之斷層？美國加州也常發生斷層所引起的地震，其斷層型式與九二一者有什麼不同？
7. 塊體運動（mass wasting）常造成許多地質災害，（a）試敘述影響塊體運動的因素，（b）如何防治一個可能發生塊體運動的不穩定邊坡？
8. 何謂 metamorphic foliation? 請說明 foliation 是如何形成的？
9. 沈積岩可分為那兩大類型？要如何區分這兩大類型的沈積岩？各舉二例說明之。
10. 試述在中洋脊（mid-ocean ridge）擴張中心（spreading center）處所發生的各種地質作用，並討論這些作用對海水中所含元素的影響以及和深海礦床間的關係。

國立中山大學九十學年度碩博士班招生考試試題

科目：海洋物理學【海資系碩士班】丙組選考

1. 潮汐和潮流之間有何關連? 何謂分潮? 何謂 M_2? 何謂 diurnal tide? (9 分)

2. 說明海洋與大氣之間的熱量如何平衡? (9 分)

3. CTD 可以測量些什麼? 如何由 CTD 資料來繪製 T-S 圖? 試繪一張 T-S 圖? 它有何功用? (10 分)

4. 描述行星風系概況(如 trade winds, westerlies)? 說明太平洋的赤道流場及副熱帶環流概況? 此流場與風場有何關係? (10 分)

5. 地衡流(geostrophic current)是怎樣形成的? 繪圖說明其流向與受力平衡的關係。地衡方法是如何推算洋流的? 譬如說，動力高度分布圖△D = 0/1000 dbar，表示什麼意思? (10 分)

6. 沿岸海洋與大洋有何差異? 造成差異的原因是什麼? 河口(estuary)依據海水性質的分佈可分成哪幾類? 繪其鹽度垂直分佈圖。 (10 分)

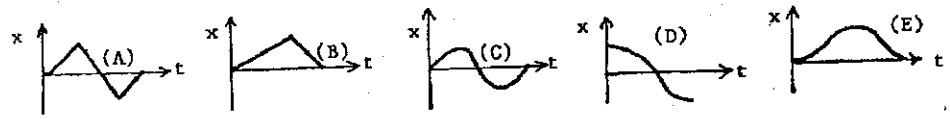
解釋名詞(每題 6 分)

1. El Nino
2. Ekman spiral
3. sound channel
4. sigma-t
5. potential temperature
6. internal wave
7. westward intensification of boundary current

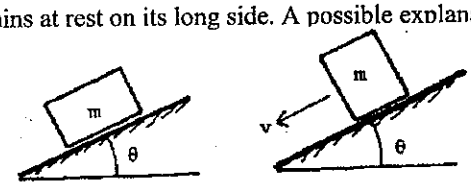
一，選擇題部份共有十題，每題 5 分。每題只有一個答案是正確的，請將正確答案選項寫在答案卷上。

(1) A car accelerates from rest on a straight road (let it be in the direction of positive x-axis). A short time later, the car decelerates to a stop and then returns to its original position in a similar manner. Which of the five following graphs best describes the motion?

a. b. c. d. e.



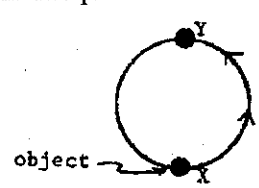
(2) A block is first placed on its long side and then on its short side on the same inclined plane as shown. The block slides down the plane on its short side but remains at rest on its long side. A possible explanation is :



(a) the short side is smoother
(b) the frictional force is less in the second case because the contact area is less
(c) the center of gravity is higher in the second case
(d) the normal force is less the second case
(e) the force of gravity is more nearly down the plane in the second case

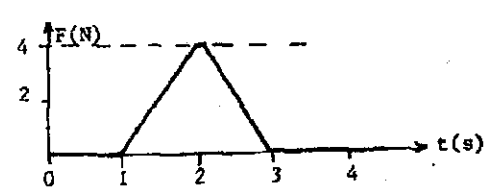
(3) A man moves the 10-g object shown in a vertical plane from position x to position Y along a circular track of radius 20 m. The process takes 0.75 min. The work done by the man is about:

(a) 1 J, (b) 2 J, (c) 4 J, (d) 6 J, (e) 12 J



(4) A 5 kg object can move along the x-axis. It is subjected to a force F in the x direction; a graph of F as a function of time t is shown below. The change in velocity of the object is:

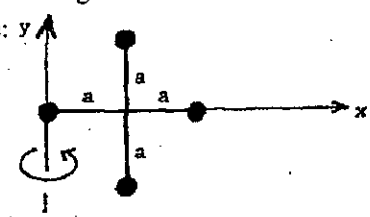
(a) 0.8 m/s, (b) 1.1 m/s, (c) 1.6 m/s,
(d) 2.3 m/s, (e) 4.0 m/s



(5) Four equal point masses m are arranged in the x-y plane as shown. They are connected by light sticks to form a rigid body. If m = 2.0 kg and a = 1.0 m, the rotational inertia about the y-axis of this array is:

(a) 4.0 kg · m^2, (b) 12 kg · m^2, (c) 9.6 kg · m^2

(d) 4.8 kg · m^2, (e) none of these



(6) Two traveling waves:

$$y_1(x,t) = A\sin[k(x-ct)]$$

and $$y_2(x,t) = A\sin[k(x+ct)]$$

are superposed on the same string. The distance between the adjacent nodes is:

(a) ct/π, (b) ct/2π, (c) π/2k, (d) π/k, (e) 2π/k

(7) Two uncharged metal spheres, L and M, are in contact, A negatively charged rod is brought close to L, but not touching it, as shown. The two spheres are slightly separated and the rod is then withdrawn. As a result:

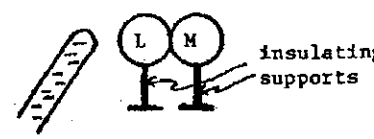
(a) both spheres are neutral

(b) both spheres are positive

(c) both spheres are negative

(d) L is negative and M is positive

(e) L is positive and M is negative



(8) The index of refraction for diamond is 2.5. Which of the following is correct for the situation shown?

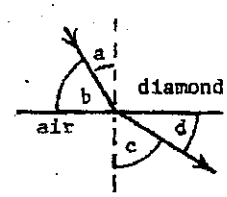
(a) (sin a)/(sin b) = 2.5

(b) (sin b)/(sin d) = 2.5

(c) (cos a)/(cos c) = 2.5

(d) (sin a)/(sin c) =1/ 2.5

(e) a/c = 2.5



(9) The figure shows a uniform magnetic field **B** directed to the left and a wire carrying a current into the page. The magnetic force acting on the wire is:

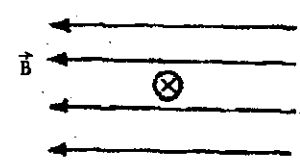
(a) toward the top to the page

(b) toward the bottom of the page

(c) toward the left

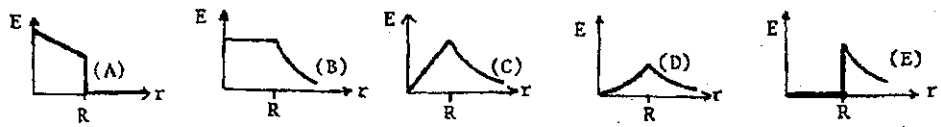
(d) toward the right

(e) zero



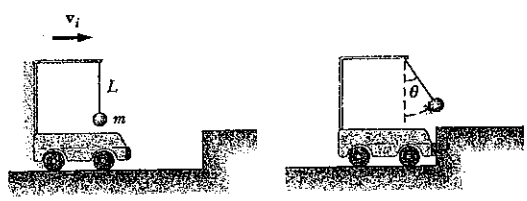
(10) A solid insulating sphere of radius R contains a uniform volume distribution of positive charge. Which of the graphs below correctly gives the magnitude E of the electric field as a function of r?

a. b. c. d. e.



二，計算題部份，共 5 題，每題 10 分。

1. An object of mass m is suspended from a post on top of a cart by a string of length L as shown in the Fig 1a. The cart and object are initially moving to the right at constant speed v_i. The cart comes to rest after colliding and sticking to a bumper as in Fig 1b, and the suspended object swings through an angle θ. Find the initial speed of the cart.



(a) Fig. 1 (b)

2. An 8.00-g bullet is fired into a 2.50-kg block that is initially at rest at the edge of a frictionless table of height 1.00 m (Fig. 2). The bullet remains in the block, and after impact the block lands 2.00 m from the bottom of the table. Determine the initial speed of the bullet.

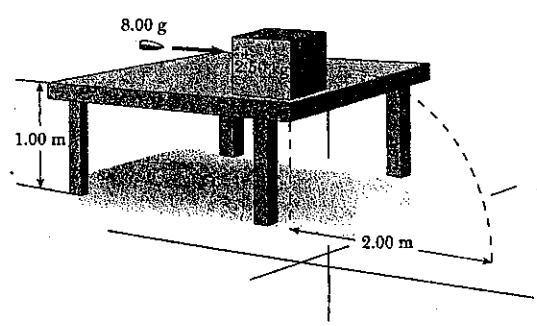


Fig. 2

3. A large storage tank is filled to a height h_o. The tank is punctured at a height h above the bottom of the tank (Fig.3). Find the expression for how far from the tank the exiting stream lands.

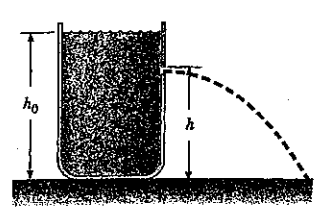


Fig. 3

4. A dead battery is charged by connecting it to the live battery of another car with jumper cables (Fig.4). Determine the current in the starter and in the dead battery.

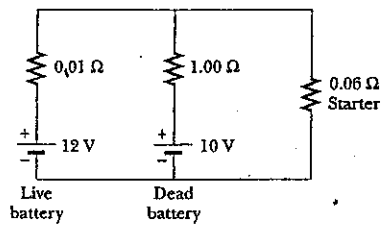


Fig. 4

5. A conducting rod of length $\ell = 35.0$ cm is free to slide on two parallel conducting bars as shown in Fig.5. Two resistors $R_1 = 2.00\ \Omega$ and $R_2 = 5.00\,\Omega$ are connected across the ends of the bars to form a loop. A constant magnetic field B = 2.50 T is directed perpendicular into the page. An external agent pulls the rod to the left with a constant speed of v = 8.00 m/s. Find
   (a) the currents in both resistors
   (b) the total power delivered to the resistance of the circuit
   (c) the magnitude of the applied force that is needed to move the rod with this constant velocity

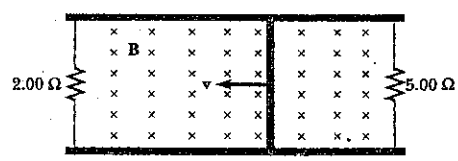


Fig. 5

國立中山大學九十學年度碩博士班招生考試試題

科目：分析化學【海資系碩士班】丁組

請注意：第 1 題至第 10 題為選擇題（單選），每題 3 分。答錯不計分，並倒扣 1 分；不做答則不計分亦不倒扣。

（3%）1. 100 ml of a NaOH solution are titrated to the endpoint (using phenolphthalein as indicator) with 10.0 ml of a 1M solution of sulfuric acid. What is the molarity of the NaOH solution?

（A）1.0 M （B）5.0×10^{-1} M （C）2.0×10^{-1} M （D）1.0×10^{-1} M

（3%）2. $Zn^{2+}+2e^{-}\rightarrow Zn$ $E^0 = -0.76$ V

$Cr^{3+}+3e^{-}\rightarrow Cr$ $E^0 = -0.74$ V

The anode in this cell is

（A）Zn （B）Zn^{2+} （C）Cr （D）Cr^{3+}

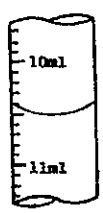
（3% ）3. The buret on the right reads：

（A）11.45 ml

（B）10.50 ml

（C）10.5 ml

（D）10.4 ml



（3% ）4. 10^{-9} meter is

（A）1 mm （B）1 μm （C）1 nm （D）1 pm

（3% ）5. $H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$

The equivalent weight of H_2CO_3 in dissociation reaction as shown above is

（A）30 （B）31 （C）61 （D）62

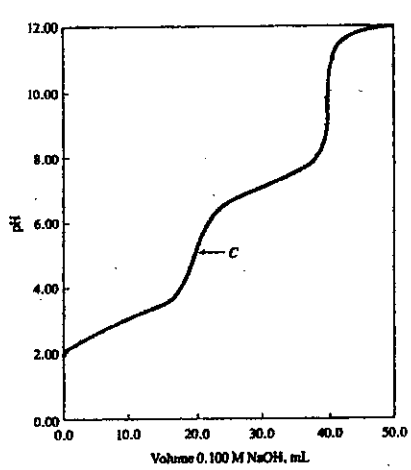
（3% ）6. The figure below is the titration curve of a diprotic acid H_2A with dissociation constants of $Ka_1=1.00\times10^{-3}$ and $Ka_2=1.00\times10^{-7}$. What is (are) the major component(s) at point *C*?

（A）H_2A and HA^-

（B）HA^- and A^{2-}

（C）H_2A

（D）HA^-



（3% ）7. The standard deviation is a measure of

（A） precision

（B） accuracy

（C） both of above

（D） none of above

（3% ）8. The K_a of HCN is 6.2×10^{-10}. What is the equilibrium constant K_b for the following reaction ?

$CN^- + H_2O \rightleftharpoons HCN + OH^-$

（A）1.6×10^{-5} （B）6.2×10^{-10} （C）$6.2\times10^{-10}\times K_w$ （D）$6.2\times10^{-10}/K_w$

（3% ）9. The pK_a of formic acid is 3.75. What is the pH of a solution that is 0.100 M in formic acid and 1.00 M in sodium formate ?

（A）13.75 （B）4.75 （C）3.75 （D）2.75

（3% ）10. The pOH of a 0.0001 M HCl solution is

（A）4 （B）7 （C）10 （D）14

（5% ）11. How many grams of $Ba(IO_3)_2$ （487 g/ mole）can be dissolved in 500 ml of water at 25℃ ?（K_{sp} of $Ba(IO_3)_2$ is 1.372×10^{-9}）

（5% ）12. Why are iodine solutions prepared by dissolving I_2 in concentrated KI ?

（15% ）13. Name three types of systematic errors and briefly explain each of them .

（10% ）14. （a）Calculate the thermodynamic potential of the following cell

$Cu|Cu^{2+}$ (0.01 M)$||Ag^+$ (0.01 M)$|Ag$

（b）Calculate the equilibrium constant of the redox equation involved in the cell above.

（ $Ag^+ + e^- \rightarrow Ag$ $E^0 = 0.799$ V,

$Cu^{2+} + 2e^- \rightarrow Cu$ $E^0 = 0.337$ V ）

（15% ）15. Describe or define the following terms in potentiometric analysis.

（a） reference electrode

（b） indicator electrode

（c） liquid-junction potential

（10% ）16. According to Beer's law, absorbance is linearly related to the concentration of the absorbing species and the path length of the radiation in the absorbing medium. Identify factors that cause the Beer's law relationship to depart from linearity.

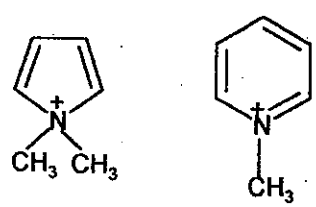
（10% ）17. Show the basic structure and describe the principle of flame atomic absorption spectrometer.

1. Explain the following terms (4% each)
   (a) Aldol condensation
   (b) Claisen condensation
   (c) Reformastsky reaction
   (d) Wittig reaction
   (e) Electrophilic aromatic substitution
   (f) Recemic modification

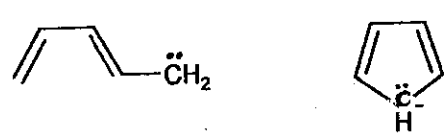
2. Write structures for compounds that belong in the following classes (2% each)
   (a) β,γ-Unsaturated-δ-lactone
   (b) Cyclic unsaturated anhydride
   (c) Oxime of an aromatic letone
   (d) γ-Diketone
   (e) Semicarbazone

3. Compare the stability of each of the following pairs of organic ions (2% each)
   (a)

   (b)



   (c)

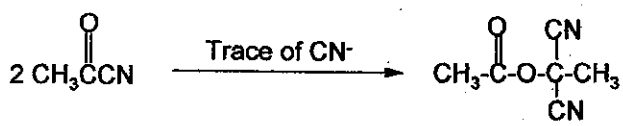


   (d)

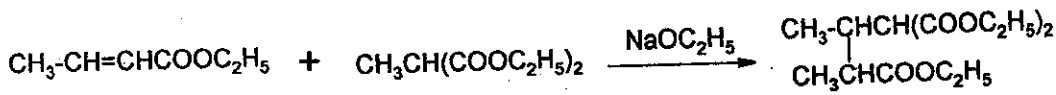
4. When the *cis* and *trans* 3,3-dimethyl-2-bromo-cyclohexanols are treated with strong bases, they each yield a single product. The products are isomeric, halogen free, and only the one from the *cis*-bromo alcohol shows an IR band at 1710 cm^{-1}. Neither product shows an IR band around 3350 cm^{-1} like the starting materials. Explain. (5%)

5. Write mechanism for each of the following reactions (5% each)

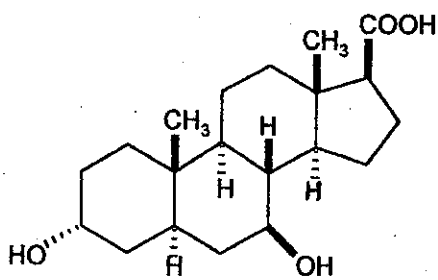
(a)



(b)



6. A derivative of the steroid, cholic acid, found in human gallstone, is shown below:

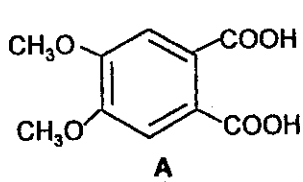


(a) Draw the molecule in its most stable conformation. Does it have more than one? (3%)

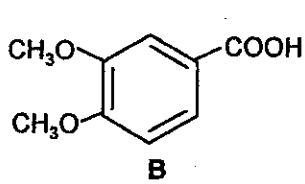
(b) Are the epimers at the carbon bearing –OH more or less stable? (3%)

(c) How many stereoisomers are possible if the asymmetric carbon configurations are not specified as they are in this representation? (3%)

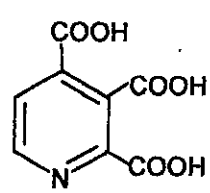
7. Papaverine, one of the alkaloid in *Opium*, has the formula $C_{20}H_{21}NO_4$. Hot permanganate oxidation yielded the following three acids, as proved by synthsis. What is the structure of papaverine? (Note: Acid A is not the source of acid B under these condition). (5%)



A

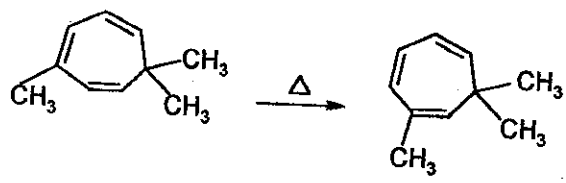


B



C

8. Account for the following observation. (4%)



9. If we measure the mass spectrum or infrared spectrum of an unknown compound and find it to be identical with the spectrum of a previously reported compound of known structure, then we can conclude that the two compounds are identical. Why? (6%)

10. Where an infrared spectrum shows many sharp peaks, a typical ultraviolet spectrum shows a few broad bumps. Why? (4%)

11. In a ^{1}H NMR spectrum,

(a) The number of peaks (N) into which a proton signal is split equals one more than the number of vincinal protons (n):

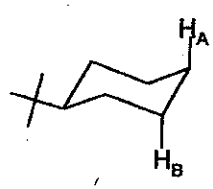
N = n+1 N = 2 (one vincinal H) = doublet (⫫ , 1:1)

N = 3 (two vincinal H) = triplet (⫴ , 1:2:1)

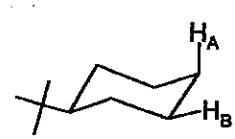
Explain this by the spin states (↑ or ↓) of neighboring protons. (5%)

(b) What is coupling constant? Explain the mechanism of proton-proton coupling. (5%)

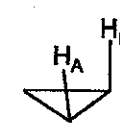
(c) Compare the values of the following coupling constants (J, in Hz) by orbital overlap. (5%)



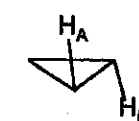
J_{AB} = 11-14 Hz



J_{AB} = 4-5 Hz



J_{AB} = 10-12 Hz



J_{AB} = 7-8 Hz