

國立中山大學 96 學年度碩士班招生考試試題

科目：普通生物學【海資系碩士班甲組】

共 1 頁 第 1 頁

- 一、神經細胞的靜止膜電位 (Resting membrane potential) 如何形成？(10 分)。動作電位 (Action potential) 如何形成？(10 分)。
- 二、請以能量觀點說明生物由單細胞演化為多細胞的優勢。(15 分)
- 三、請詳述動物生殖策略的演進。(15 分)
- 四、(10%) What is the innate immunity that provides broad defenses against infection in humans?
- 五、(10%) Chromosome structure can affect gene expression in eukaryotes. How the structure is controlled and its relation to the activities of gene expression?
- 六、(10%) Please describe the mechanism of ATP production from glucose in eukaryotes.
- 七、(10%) The human genome contains a significant portion of long interspersed elements (LINEs). What are LINEs and how do they propagate?
- 八、(10%) Fill in the blanks

	<i>Saccharomyces cerevisiae</i>	<i>Escherichia coli</i>	Phage lambda
Genomic size (Kb)	_____	_____	_____
Form of genetic material	_____	_____	_____
Dimension	_____	_____	_____

國立中山大學 96 學年度碩士班招生考試試題

科目：生理學【海資系碩士班甲組選考】

共 / 頁 第 / 頁

- 一、請詳述人體如何調控滲透壓 (Osmolarity) ? (30 分)
- 二、請詳述人體如何控制呼吸速率? (30 分)
- 三、繪圖說明如何形成心肌細胞 (Cardiac muscle) 的動作電位 (action potential)。(20 分)
- 四、詳述女性排卵的控制機制。(20 分)

國立中山大學 96 學年度碩士班招生考試試題

科目：生物化學【海資系碩士班甲組選考】

共 1 頁 第 1 頁

1. Draw the structures of glucose and fructose. (10%)
2. What are the English names of twenty amino acids that are of highly frequent occurrences in most of proteins? (20%)
3. What are the secondary structures of a protein? (10%)
4. What are the functions of cellular receptors for different tissues? (10%)
5. Please translate the following passage, which is a figure legend from a textbook, into Chinese. What is the best title for the figure? (25%)

Fig. 1. xxxx (title). (a) Observation that double mutants with two defective proteins (A and B) have a wild-type phenotype but that single mutants give a mutant phenotype indicates that the function of each protein depends on interaction with the other. (b) Observation that double mutants have a more severe phenotypic defect than single mutants also is evidence that two proteins (e.g., subunits of a heterodimer) must interact to function normally. (c) Observation that a double mutant is nonviable but that the corresponding single mutants have the wild-type phenotype indicates that two proteins function in redundant pathways to produce an essential product.

6. Describe the following acronyms in term of their original words in English and explain their significant roles in biological system. (10%)
 - (a) ATP
 - (b) RNA
 - (c) PCR
 - (d) *cdc*
 - (e) VLP

7. 中翻英(15%)

昆蟲透過攝食被病毒污染的植物而感染。病毒顆粒進入腸腔後，消化酵素會將包裹在病毒顆粒外層的多面體結晶蛋白加以分解，再經過一連串細胞攝入動作，使得病毒 DNA 逐漸裸露而傳入昆蟲細胞核內進行複製，生產出新病毒顆粒。經溶破細胞釋出大量的新生病毒，再感染其他細胞及組織。如此週而復始地感染則導致大塊組織遭受破壞，在昆蟲死亡時其角質層內幾乎佈滿病毒。

國立中山大學96學年度碩士班招生考試試題

科目：生態學【海資系碩士班乙組】

共2頁第1頁

一. 選擇題 (10%) (單選，每題2分，答錯倒扣1分)

- () 1. 在生態系生地化循環理論敘述中，下列敘述何者是錯誤的 A)磷循環比氮循環簡單 B)磷大量儲存於岩石及海洋中 C)海鳥在氮循環中扮演一重要的角色 D)人類活動加速磷流失的速度 E)以上皆是
- () 2. 根據Diamond(1976)之自然生態保護區設置原則，下列何者為非？A)保護區面積越大越好 B)條狀保護區要比圓形保護區好 C)若干分隔的小保護區越靠近越好 D)單個保護區要比面積相同，但分隔成若干小保護區好 E)若干分隔的小保護區越靠近越好
- () 3. 下列哪種生態系的生產量最高 A) Open sea B) Estuaries C) Coral reefs D) Tundra E) Temperate evergreen forests
- () 4. 脫氮細菌的作用過程是 A) $N_2 \rightarrow NO_3^- \rightarrow NH_4^+$ B) $NH_4^+ \rightarrow NO_3^- \rightarrow N_2$ C) $NH_4^+ \rightarrow N_2 \rightarrow NO_3^-$ D) $NO_3^- \rightarrow N_2 \rightarrow NH_4^+$ E) $NO_3^- \rightarrow NH_4^+ \rightarrow N_2$
- () 5. CAM (Crassulacea Acid Metabolism) 是那一類植物所特有的生理機制？
A)蘆葦 B)水筆仔 C)山酢醬草 D)仙人掌 E)小麥

二. 解釋名詞(30%)(每題5分)

- | | |
|-------------------------|--|
| 1. Sibling species | 2. Cline |
| 3. Resistance stability | 4. Bioturbation |
| 5. Red tide | 6. PDO (Pacific Decadal Oscillation) index |

三. 問答題 (60%)

1. 近幾年來，東北亞海域，包括東海、黃海、渤海及日本海域等，均連續性地出現超大體型水母大量增生及群集的情形，中日韓政府因而緊急召開三國聯席會議研商對策。請問 1). 水母是什麼東西？ 2). 牠的生態習性為何？ 3). 造成水母大量增生的可能原因為何？ 4). 水母大量增生的可能影響為何？ (20分)

國立中山大學 96 學年度碩士班招生考試試題

科目：生態學【海資系碩士班乙組】

共 2 頁 第 2 頁

2. 請繪製並說明一典型之海洋生態模式圖。(11分)
3. 生物多樣性已成為現今國際生態學者所熱衷關切的話題，請敘述何謂“生物多樣性”？生物多樣性消失的原因有哪些？(20%)
4. 下列為不同種間相互作用形態的專有名詞及說明，請將所附說明之代號(A~I)填入最適當空格內。(9%，每個空格1分)

Type of interaction:

- | | |
|---|----------------------|
| () 1. Competition: direct interference type, | () 2. Mutualism, |
| () 3. Predation (including herbivory), | () 4. Neutralism, |
| () 5. Competition: resource use type, | () 6. Parasitism, |
| () 7. Amensalism, | () 8. Commensalism, |
| () 9. Protocooperation. | |

General nature of interaction

- A). Population 1, the commensal, benefits, while 2, the host, is not affected.
- B). Population 1 eat population 2 and their body sizes are generally larger than population 2.
- C). Interaction favorable to both and obligatory.
- D). Indirect inhibition when common food or space is in short supply.
- E). Neither population affects the other.
- F). Direct inhibition of each species by the other
- G). Population 1 inhibited, 2 not affected.
- H). Population 1 eat population 2 and generally smaller than population 2, the host.
- I). Interaction favorable to both but not obligatory

國立中山大學 96 學年度碩士班招生考試試題

科目：生物統計學【海資系碩士班乙組】

共 / 頁 第 4 頁

(25%)1. 下圖為採自 *Limnology and Oceanography* (50(4), 2005, 1149-1158) 的一個研究結果。該研究探討沿岸(A)與外洋(B)的兩種矽藻(diatom)，對鐵(Fe)之吸收速率是否受鐵濃度與銅(Cu)濃度的影響。利用此圖及圖之說明，請回答以下問題：

- (1) 就統計結果而言，兩種矽藻反應有什麼相似及相異處？(10%)
- (2) 對 Fe 吸收速率而言，銅濃度與鐵濃度間，是否可能存在顯著的“互涉”(interaction)?

請 (a) 下結論，並以圖或數據輔助說明你的論點 (10%)

(b) 說明何謂“互涉”(interaction)? (5%)

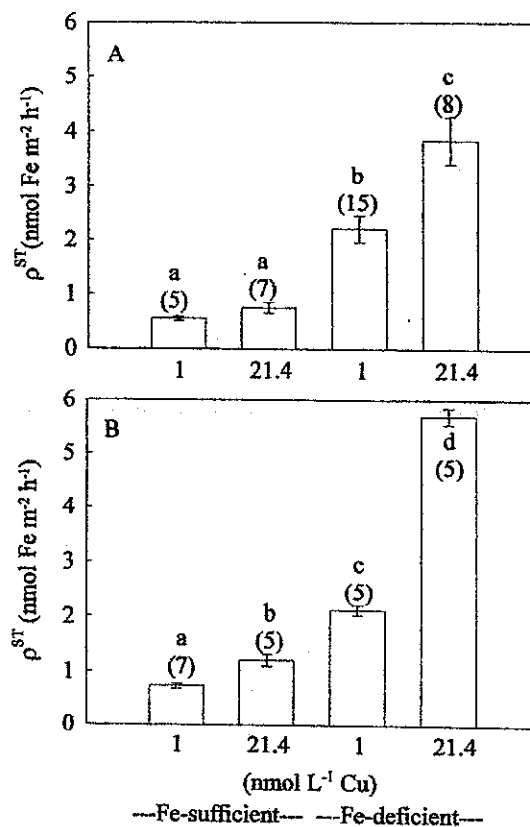


Fig. 2. Short-term Fe uptakes (ρ^{ST}) of a coastal and oceanic diatom, *T. weissflogii* (CCMP 1336) (A) and *T. oceanica* (CCMP 1005) (B), acclimated to different concentrations of Fe and Cu. Uptake rates were measured using 50 nmol L^{-1} Fe equilibrated with $100 \text{ } \mu\text{mol L}^{-1}$ EDTA. Values are reported as means \pm standard error. Treatments marked with different letters are significantly different ($p < 0.05$, ANOVA, Tukey) and the numbers in parentheses represent the number of independent replicates.

國立中山大學 96 學年度碩士班招生考試試題

科目：生物統計學【海資系碩士班乙組】

共 2 頁 第 4 頁

(15%) 2. 在大學內對某件事舉行一次公意投票，投“贊成”的有 204 人，投“不贊成”的有 196 人。由此結果能不能下結論為大部分的人是“贊成”的？請以統計方法分析 ($\alpha=0.05$)。

(40%) 3. 為了要測試冰藏對魚保鮮品質的影響，捕了 10 條同種且體型大小相似的魚，其中兩條在捕獲後立刻冰藏，兩條在捕獲後 3 小時冰藏，各有兩條分別在捕獲後 6 小時，9 小時，12 小時冰藏。冰藏 20 天後測量魚品質（以 10 分為滿分計點），所得數據如下：

Storage Time (hour)				
0	3	6	9	12
8.5	7.9	7.8	7.3	6.8
8.4	8.1	1.6	7.0	6.7

進行變方分析 (Analysis of Variance, 表一) 及直線迴歸 (Linear Regression, 表二) 分析結果如下：

(表一) 變方分析

Source of variation	Sum of square	Degree of freedom	Mean square	F-test
Treatment	3.634	B	E	G
Error	A	C	F	
Total	3.729	D		

(表二) 迴歸分析

Source of variation	Sum of square	Degree of freedom	Mean square	F-test
Regression	H	J	M	O
Error	0.1165	K	N	
Total	I	L		

請(1) 回答表一及表二內，標示 A 至 O 之空格（答案請依序寫在答案卷上，每空格 2%，計 30%）

(2) 說明並比較用變方分析(表一)及直線迴歸分析(表二)之結果與結論，有何相似及相異點？(10%) ($\alpha=0.05$)

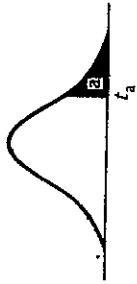
(20%) 4. 某工廠針對有機污染物對河川影響，裝置一淨水系統。為瞭解此淨水系統是否可以有效提高水中溶氧，在工廠排水口隨機取 64 個水樣，檢測水中溶氧濃度(以 ppm 為單位)，得到樣品平均值為 5.4，變方(variance) $S^2=0.64$ ，而已知去年未裝置淨水系統時平均為 5.2 ppm。請分析並對此淨水系統的效果下結論($\alpha=0.05$)。

國立中山大學 96 學年度碩士班招生考試試題

科目：生物統計學【海資系碩士班乙組】

附表 2

Table 2 Percentage points of the *t* distribution

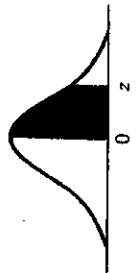


df	a = .10	a = .05	a = .025	a = .010	a = .005
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.192	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
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.

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	.3868	.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 1 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.

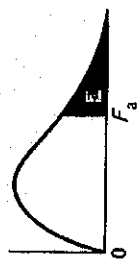
國立中山大學 96 學年度碩士班招生考試試題

科目：生物統計學【海資系碩士班乙組】

共 4 頁 第 4 頁

附表 3

Table 3 Percentage points of the F distribution



Degrees of freedom (a = .05)

$df_1 \backslash df_2$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53
12	4.75	3.89	3.49	3.26	3.11	3.00	2.92	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	2.00	1.92	1.84	1.75	1.70	1.65	1.59
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39

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. Repro-

國立中山大學96學年度碩士班招生考試試題

科目：普通地質學【海資系碩士班丙組選考】

共 / 頁 第 / 頁

一、解釋名詞 (18%，每小題 3 分)

- | | |
|---------------|----------------|
| 1、exfoliation | 4、index fossil |
| 2、schistosity | 5、unconformity |
| 3、subduction | 6、creep |

二、簡答題 (42%，每小題 6 分)

- 1、在野外你如何辨識一個岩石是受到化學風化 (chemical weathering or decomposition) 或是物理風化 (physical weathering or disintegration)？
- 2、(a) 沉積岩是根據什麼特性來分類？
(b) 從沉積物轉變成沉積岩需經歷那些作用？
- 3、一個石英岩 (quartzite) 和一個砂岩 (sandstone) 有什麼不同？例如成份、礦物組成、組織、成因上的特性有何不同。
- 4、有那些地層的構造或特徵可以用來判斷地層的上下層序？
- 5、影響塊體運動 (mass wasting) 的主要因素有那些？
- 6、影響風化作用的因素有那些？
- 7、說明變質岩中的葉理 (foliation) 是如何形成的？其和岩石的節理 (joint) 有甚麼不同？

三、問答題 (40%，每小題 10 分)

- 1、為什麼我們需要地質學？
- 2、地球四大圈層，氣圈、水圈、岩石圈、與生物圈之間密切相關連，試舉一個地質相關的例子詳細說明地球四大圈層之間的密切關連性。
- 3、(a) 熔岩的黏滯性 (viscosity) 取決於那些因素？(b) 分離板塊界線處的火山和聚合板塊界線處的火山有什麼差異性？其和熔岩黏滯性有什麼關係？
- 4、(a) 喀斯特地形 (Karst topography) 有什麼特徵？有些什麼特別的地形景觀？(b) 並說明其成因。

國立中山大學 96 學年度碩士班招生考試試題

科目：普通物理學【海資系碩士班丙組選考】

共 3 頁 第 1 頁

1. A particle moves along the x axis according to the equation $x = 2.00 + 3.00t - 1.00t^2$, where x is in meters and t is in seconds. At $t = 3.00$ s, find (a)(2%) the position of the particle, (b)(4%) its velocity, and (c) (4%) its acceleration.

2.(10%) A simple accelerometer is constructed inside a car by suspending an object of mass m from a string of length L that is tied to the car's ceiling. As the car accelerates the string-object system makes a constant angle of θ with the vertical. Assuming that the string mass is negligible compared with m , derive an expression for the car's acceleration in terms of θ and show that it is independent of the mass m and the length L .

3. A 5.00-kg block is set into motion up an inclined plane with an initial speed of 8.00 m/s (Fig.1). The block comes to rest after traveling 3.00 m along the plane, which is inclined at an angle of 30.0° to the horizontal. For this motion, determine (a) (3%) the change in the block's kinetic energy, (b)(3%) the change in the potential energy of the block-Earth system, and (c)(2%) the friction force exerted on the block (assumed to be constant). (d) (2%) What is the coefficient of kinetic friction?

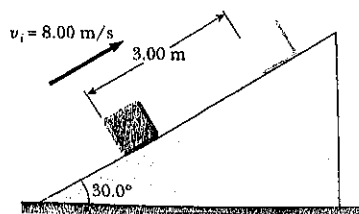


FIGURE 1

4. (10%) As shown in Fig.2, a bullet of mass m and speed v passes completely through a pendulum bob of mass M . The bullet emerges with a speed of $v/2$. The pendulum bob is suspended by a stiff rod of length l and negligible mass. What is the minimum value of v such that the pendulum bob will barely swing through a complete vertical circle?

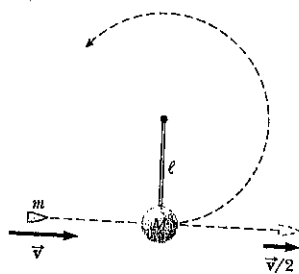


FIGURE 2

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科目：普通物理學【海資系碩士班丙組選考】

共 3 頁 第 2 頁

5. Two blocks, as shown in Fig.3, are connected by a string of negligible mass passing over a pulley of radius 0.250 m and moment of inertia I . The block on the frictionless incline is moving up with a constant acceleration of 2.00 m/s^2 . (a) (7%) Determine T_1 and T_2 , the tensions in the two parts of the string. (b) (3%) Find the moment of inertia of the pulley.

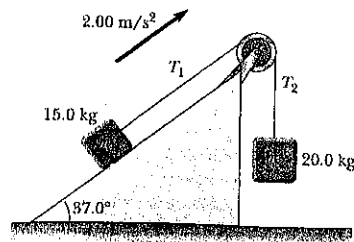


FIGURE 3

6. (a) (5%) Write the expression for y as a function of x and t for a sinusoidal wave traveling along a rope in the negative x direction with the following characteristics: $A = 8.00 \text{ cm}$, $\lambda = 80.0 \text{ cm}$, $f = 3.00 \text{ Hz}$, and $y(0, t) = 0$ at $t = 0$. (b) (5%) Write the expression for y as a function of x and t for the wave in part (a) assuming that $y(x, 0) = 0$ at the point $x = 10.0 \text{ cm}$. (A is amplitude, λ is wavelength, f is frequency of the wave)

7. A vertical cylinder of cross-sectional area A is fitted with a tight-fitting, frictionless piston of mass m (Fig.4). (a) (8%) If n moles of an ideal gas are in the cylinder at a temperature of T , what is the height h at which the piston is in equilibrium under its own weight? (b) (2%) What is the value for h if $n = 0.200 \text{ mol}$, $T = 400 \text{ K}$, $A = 0.00800 \text{ m}^2$, $m = 20.0 \text{ kg}$, and universal gas constant $= 8.314 \text{ J/mol}\cdot\text{K}$. (Note: The cylinder is put in the atmosphere and the atmospheric pressure P_0 is $1.013 \times 10^5 \text{ Pa}$, $1 \text{ Pa} = 1 \text{ N/m}^2$)

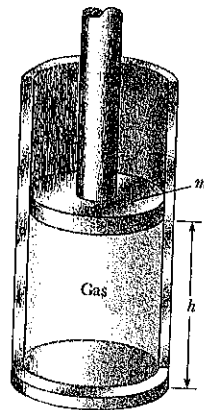


FIGURE 4

國立中山大學 96 學年度碩士班招生考試試題

科目：普通物理學【海資系碩士班丙組選考】

共 3 頁 第 3 頁

8. (10%) A uniformly charged insulating rod of length 14.0 cm is bent into the shape of a semicircle as shown in Fig.5. The rod has a total charge of $-7.50 \mu\text{C}$. Find the magnitude and direction of the electric field at O, the center of the semicircle. (Coulomb constant

$$k_e = \frac{1}{4\pi\epsilon_0} = 9.0 \times 10^9 \text{ N} \cdot \text{m}^2 / \text{C}^2)$$

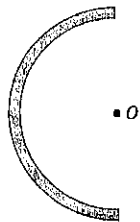


FIGURE 5

9. (10%) A spherical capacitor consists of a spherical conducting shell of radius b and charge $-Q$ that is concentric with a smaller conducting sphere of radius a and charge $+Q$ (Fig.6). Show that its capacitance is

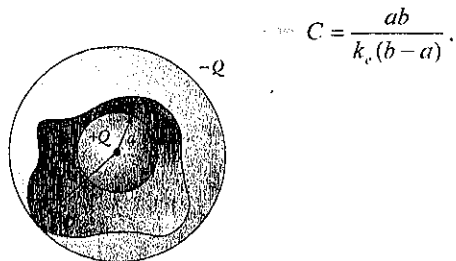


FIGURE 6

$$C = \frac{ab}{k_e(b-a)}$$

10. (10%) A light beam passes from medium 1 to medium 2, with the latter being a thick slab of material whose thickness is d . Their indexes of refraction are n_1 and n_2 , respectively. Show that the emerging beam is parallel to the incident beam.

國立中山大學 96 學年度碩士班招生考試試題

科目：微積分【海資系碩士班丙組選考】

共 1 頁 第 1 頁

1. (20pts) Compute the following limits. Write "does not exist" if the limit does not exist.

$$(i) \lim_{t \rightarrow \infty} (t - te^{\frac{1}{t}}), \quad (ii) \lim_{x \rightarrow 0} \frac{\int_0^x \cos t^2 dt}{\int_0^x e^{t^2} dt}.$$

2. (10pts) Find the equations for the tangent lines and the normal lines at the specified point.

$$xy^2 - yx^2 = 0; (1, 1).$$

3. (10pts) Let $f(x) = x^m(x-1)^n$, where m and n are integers greater than or equal to 2. Determine the values of m and n for which $f(1/4)$ is a relative extreme values of f .

4. (10pts) Sketch the graph of the function

$$f(x) = 3x^4 - 4x^3.$$

Indicate (i) x -intercepts (ii) y -intercept (iii) relative maxima and minima (iv) points of inflections (v) concavity and (vi) asymptotes.

5. (30pts) Compute the following integrals.

$$(i) \int \sqrt{2+x^2} dx, \quad (ii) \int \frac{1}{1+x^{\frac{1}{3}}} dx, \quad (iii) \int_{-1}^1 \frac{\sin x + x^3 + 1}{1+x^2} dx.$$

6. (10pts) Find the maximum volume of a right circular cylinder contained in the sphere with radius R in \mathcal{R}^3 .

7. (10pts) Let x_0 and A are positive real numbers, prove that the sequence

$$\begin{aligned} x_1 &= \frac{1}{2}\left(x_0 + \frac{A}{x_0}\right), \\ x_2 &= \frac{1}{2}\left(x_1 + \frac{A}{x_1}\right), \dots \\ x_n &= \frac{1}{2}\left(x_{n-1} + \frac{A}{x_{n-1}}\right), \dots \end{aligned}$$

converges to \sqrt{A} .

國立中山大學 96 學年度碩士班招生考試試題

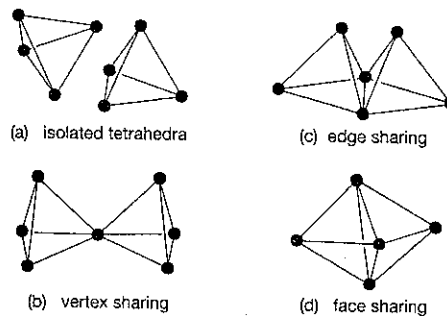
科目：礦物學【海資系碩士班丙組選考】

共 3 頁 第 1 頁

第 1 頁，共 3 頁

一、簡答題 (25%，每題 5 分)

- 1、石棉 (asbestos) 是一個商業名詞，泛指可作工業利用的石棉狀礦物，請問常見的石棉礦物主要來自那兩大類礦物群？分類上其分別屬於何種結構之礦物？
- 2、何謂 pegmatite？其有什麼特色與價值？
- 3、礦物的顏色 (color) 和游彩 (play of colors) 在成因上有什麼不同？
- 4、何謂 solid solution？並舉出一 solid solution 礦物的例子，寫出其成份。
- 5、根據包力 (Pauling's) 第三個規則，指出相連或共用多面體 (coordinating polyhedra) 時，例如共用多面體的邊或共用多面體的面等情形，哪些情形比較穩定？哪一種情形會是最不穩定 (參見下圖)，試說明其理由。



二、問答題 (75%，第 1~5 和第 7 題，每題 10 分，第 6 題 15 分)

- 1、礦物晶體的外部對稱和內部對稱有什麼差異性？並舉對稱例子作說明。(10%)
- 2、下列符號分別代表什麼意義：(10%)
(a) (hkl) , (b) $\{hkl\}$, (c) $[uvw]$, (d) $6mm$, (e) $I432$
- 3、石英、長石、和方解石都是常見的造岩礦物，請問在野外或室內，不要藉助儀器，可以利用它們的哪些物理性質來區分這三種礦物？並說明其物理性質特徵。(10%)
- 4、有一個斜方晶系的礦物—黃玉 (topaz)，其單位晶面 (111) 以及其他晶面分別截切三個結晶軸之截距如下：(10%)

Unit face	(111)	Face A	Face B	Face C	Face D	Face E
a 軸截距	0.393	0.405	0.324	0.340	0.117	0.247
b 軸截距	0.742	0.765	1.224	∞	0.330	0.234
c 軸截距	0.353	0.728	0.194	0.611	0.314	∞

請求出結晶面 A~E 之米勒指數 (Miller indices)

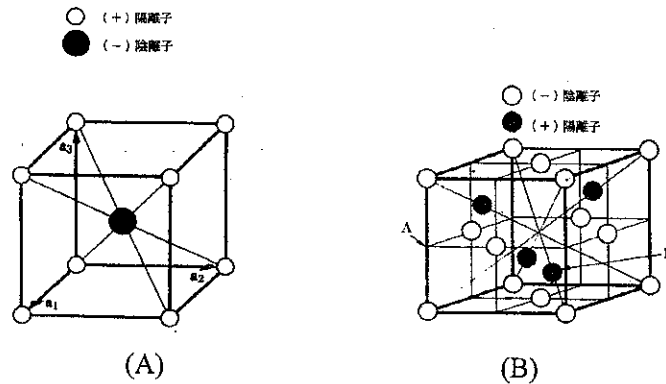
國立中山大學 96 學年度碩士班招生考試試題

科目：礦物學【海資系碩士班丙組選考】

共 3 頁 第 2 頁

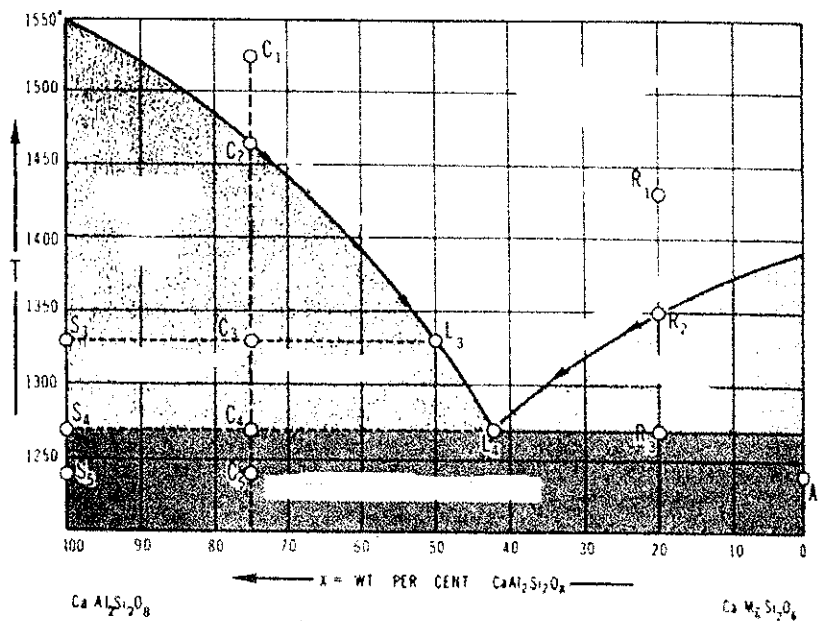
第 2 頁，共 3 頁

- 5、下圖的 (A) 和 (B) 兩個圖為兩種礦物的結構圖，請分別說明其 (a) Bravais lattice 型式、
(b) 陽離子配位數、與 (c) 結構名稱。(10%)



- 6、下圖為一個「二成份相圖」(binary phase diagram)，兩個端成份分別為 $\text{CaAl}_2\text{Si}_2\text{O}_8$ 和 $\text{CaMgSi}_2\text{O}_6$ 。(15%)

- (a) 寫出兩個端成份之礦物中英文名稱。
(b) 當一岩漿的成份如 C_1 ，依序降溫，從 C_1 到 C_5 之五個階段中，說明在此系統中發生什麼變化？並分別列出有什麼相的存在或產生（例如 C_3 階段， S_3 與 L_3 代表什麼意義）。



國立中山大學 96 學年度碩士班招生考試試題

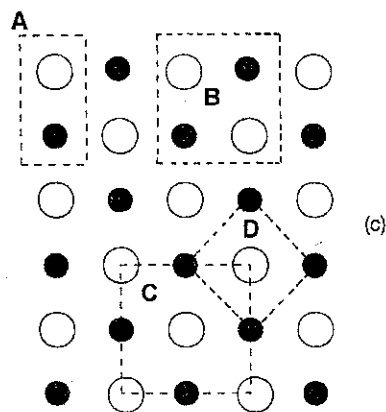
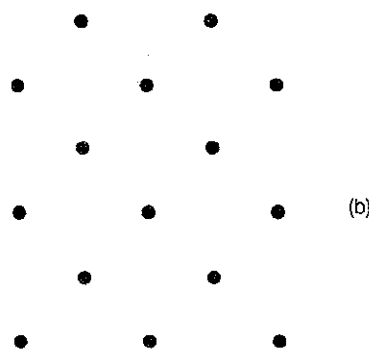
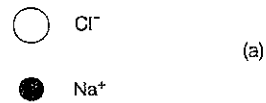
科目：礦物學【海資系碩士班丙組選考】

共 3 頁 第 3 頁

第 3 頁，共 3 頁

7、參閱下圖，回答以下問題（填入空格）（10%）

- (a) 圖代表一個基本的 motif，是由一個 Na 和一個 Cl 離子所構成，
- (b) 圖可以看作是由這樣的 motif 經由 _____ 的運作在二度空間形成的一個 _____。
- (c) 圖代表二度空間上的 NaCl 結構，請問在繪出的四個（A~E）晶胞（unit cell）中，_____ 是屬於 primitive cell，_____ 是屬於 non-primitive cell。其中，那一個晶胞是最合適的選擇：_____，為什麼？：



國立中山大學 96 學年度碩士班招生考試試題

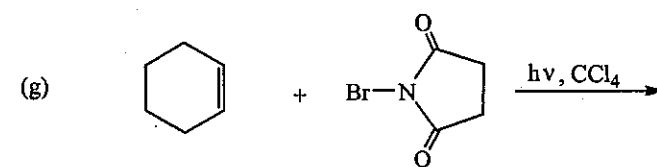
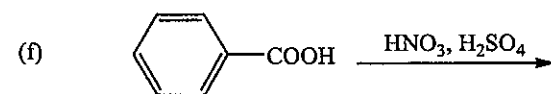
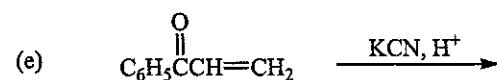
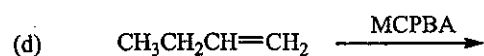
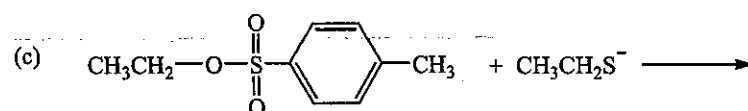
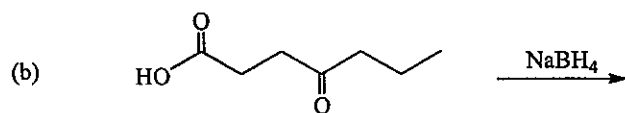
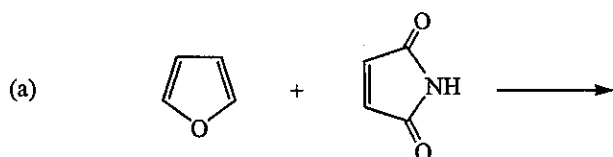
科目：有機化學【海資系碩士班丁組】

共 2 頁 第 1 頁

1. Draw the structure of each of the following compounds. (20%)

- | | |
|-----------------------------------|--|
| (a) <i>N,N</i> -Dimethylbenzamide | (b) Methyl cyanoacetate |
| (c) Bicyclo[3.2.0]heptane | (d) <i>m</i> -Chloroperoxybenzoic acid |
| (e) Methyl vinyl ketone | (f) Ethyl acetoacetate |
| (g) Ethyl acrylate | (h) 2-Chloro-1,4-benzenediol |
| (i) γ -Butyrolactone | (j) Pyridine |

2. Give the expected major product of each of the following reactions. (24%)

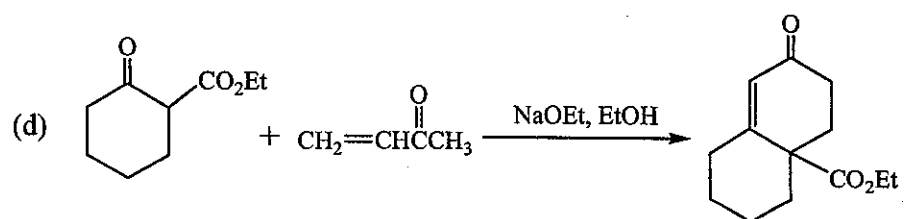
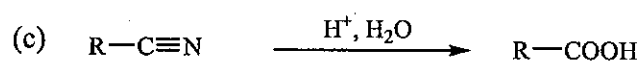
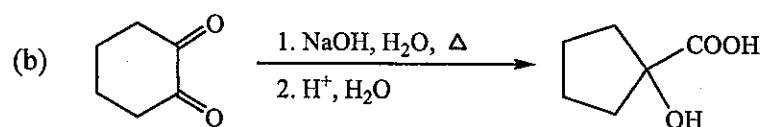
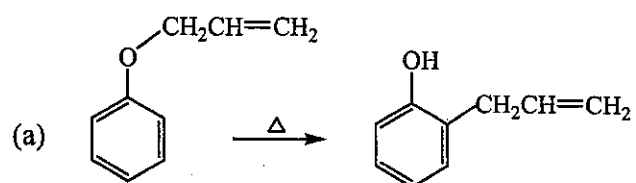


國立中山大學 96 學年度碩士班招生考試試題

科目：有機化學【海資系碩士班丁組】

共 2 頁 第 2 頁

3. Give a detailed mechanism of each of the following reactions. (32%)



4. Deduce the structure of each of the following compounds with the provided molecular formulas and NMR spectral data. (24%)

(a) $C_4H_8O_3$: δ 1.27 (3H, t, $J = 7.1$ Hz), 3.66 (2H, q, $J = 7.1$ Hz), 4.13 (2H, s), 10.95 (1H, s)

(b) $C_6H_{12}O_2$: δ 1.45 (9H, s), 1.97 (3H, s)

(c) $C_{10}H_{12}O_2$: δ 2.02 (3H, s), 2.97 (2H, t, $J = 7.3$ Hz), 4.30 (2H, t, $J = 7.3$ Hz), 7.29 (5H, s)

(d) $C_5H_{12}O_2$: δ 1.32 (6H, s), 3.20 (6H, s)

國立中山大學96學年度碩士班招生考試試題

科目：分析化學【海資系碩士班丁組】

共 2 頁 第 1 頁

請注意：(a)若涉及計算，請將演算過程列出，否則不予計分

(b) $\log 2=0.30$ 、 $\log 3=0.48$

(c)原子量：H=1、C=12、O=16、Na=23、Cl=35.5

(12%) 1. Describe the preparation of

(a) 500 mL of 4.8% (w/v) aqueous ethanol (C_2H_5OH).

(b) 500 g of 4.8% (w/w) aqueous ethanol.

(c) 500 mL of 4.8% (v/v) aqueous ethanol.

(8%) 2. Exactly 0.2120 g of pure Na_2CO_3 was dissolved in 100 mL of 0.0731 M HCl.

(a) What mass in grams of CO_2 were evolved?

(b) What was the molarity of the excess reactant (HCl or Na_2CO_3)?

(12%) 3. Explain the difference between

(a) random and systematic error.

(b) absolute and relative error.

(c) mean and median.

(8%) 4. What will be the pH of pure water at $0^\circ C$ and $100^\circ C$? (K_w is 1.00×10^{-15} at $0^\circ C$ and 4.00×10^{-13} at $100^\circ C$)

(10%) 5. What weight of CH_3COONa must be added to 500 mL of 1.00M $CHOOH$ to produce a buffer solution that has a pH of 4.50? (pK_a of CH_3COOH is 4.80)

(5%) 6. Why are standard solution of reductants less often used for titration than standard solution of oxidants?

(5%) 7. In the titration of I_2 solution with $Na_2S_2O_3$, starch indicator is never added until just before chemical equivalence. Why?

(12%) 8. Briefly describe or define the following terms of electrochemistry.

(a) indicator electrode

(b) reference electrode

(c) liquid-junction potential

(d) boundary potential

(10%) 9. Identify factors that cause the Beer's law relationship to depart from linearity.

國立中山大學96學年度碩士班招生考試試題

科目：分析化學【海資系碩士班丁組】

共2頁 第2頁

(10%)10. What is the minimum distribution constant that permits removal of 99% of a solute from 50.0mL water with

- (a) one 10.0mL extraction with toluene?
- (b) two 25.0mL extractions with toluene?

(8%)11. Two types of atomizers are usually encountered in atomic absorption spectrometer (AAS), flame and electrothermal. Which one has better sensitivity? Explain your answer in detail.