

一. 試述 水螅 (Hydrozoa), 雙殼貝 (Bivalvia), 甲殼類 (Crustacea) 及棘皮動物 (Echinodermata) 的物質運送方式。 20%

二. 何謂 chemiosmosis? 其功能為何? 並述 mitochondria 和 Chloroplast 之 chemiosmosis 有何差異? 20%

三. 為何將 Archaea (Archaeobacteria) 和 Bacteria (Eubacteria) 合為兩個上界 (domain) 10%

四. 以分子生物學觀點, 詳述 cancer (癌症) 的形成機制。 (25%)

五. 詳述動物體內化學物質傳遞訊息的機制。 (25%)

國立中山大學 八十九 學年度 碩博士班 招生 考試 試題

科 目：生態學 (海洋資源研究所 甲組 選考)

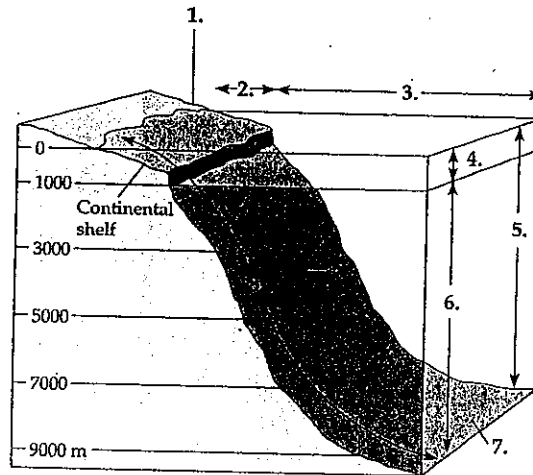
共 2 頁 第 1 頁

一、選擇題 (20 %, 單選, 答對得 2 分, 答錯倒扣 1 分)

- 1). In which are algal blooms most likely to occur?
a). headwaters of a stream, b). downstream area of a river, c). lake or pond, d). intertidal zone of an ocean, e). benthic zone of an ocean
- 2). A Type III survivorship curve would be expected in a species in which
a). mortality occurs at a constant rate over the lifespan, b). parental care is extensive, c). a large number of offspring are produced but parental care is minimal, d). mortality rate is quite low for the young, e). K-selection prevails
- 3). The current size of the human population is closest to
a). 2 million, b). 2 billion, c). 4 billion, d). 6 billion, e). 5 million
- 4). The concept of trophic structure of a community emphasizes the
a). prevalent form of vegetation, b). keystone predator, c). feeding relationships within a community, d). effects of coevolution, e). species richness of the community
- 5). According to the concept of competitive exclusion, a). two species cannot coexist in the same habitat, b). extinction or emigration are the only possible results of competitive interactions, c). intraspecific competition results in the success of the best adapted individuals, d). two species cannot share the same realized niche in a habitat, e). resource partitioning will allow a species to utilize all the resources of its fundamental niche
- 6). According to the theory of island biogeography, species richness would be greatest on an island that is, a). small and remote, b). large and remote, c). large and close to a mainland, d). large and close to a mainland, e). environmentally homogeneous
- 7). A parallel bottom community refers to which of the following?
a). The same community with the same species in two geographically separate regions. b). Similar, but not identical organisms inhabiting geographically separate regions. c). Similar bottom and sediment types with very different organisms. d). Similar organisms, but in regions with very different bottom and sediment types.
- 8). In the rocky intertidal zone which one of the following resources is in limited supply?
a). Food, b). Mates, c). Space, d). Oxygen.
- 9). A central theme in marine ecology is that whenever predation is reduced _____.
a). densities are reduced, b). competition is increased, c). competition is decreased, d). grazing pressure is decreased.
- 10). The term "compensation depth" is best to be known as;
a). The total amount of plant biomass present in a given volume of water at a given time, b). The rate of formation of energy-rich organic compounds from inorganic materials, c). The ability of green plants to use the energy of sunlight to synthesize energy-rich organic molecules from inorganic materials, d). The depth at which the rate of respiration of a plant is just equaled by the rate of photosynthesis, e). The depth at which total gross photosynthesis of the phytoplankton in the water column equals total respiration.

二、填圖表題 (31%)

1). Different marine environments can be classified on the basis of light penetration, distance from shore, and open water or bottom. Please match the following zones to their corresponding number on the diagram below: (16 %)



- _____ a. aphotic, _____ b. abyssal, _____ c. benthic, _____ d. intertidal,
 _____ e. neritic, _____ f. oceanic, _____ g. pelagic, _____ h. photic.

2). Please indicate with a + or - to show relatively high or low in oxygen level, nutrient content, and productivity of the five biomes in the following table. (15 %)

Biome	Oxygen level	Nutrient content	Productivity
a. Oligotrophic lake			
b. Eutrophic lake			
c. Headwater of stream			
d. Turbid river			
e. Estuary			

三、問答題 (49%)

- 1). Please define a species and distinguish between the concept of a morphological species and a biological species. (9%)
- 2). Please give a concise comparison of energy flow in "pelagic ecosystem" and "hydrothermal vent"? (10%)
- 3). What is "global warming"? How dose it happen and affect to our daily life? What we can do to prevent it getting worse? (10%)
- 4). Please give the definition and examples to r-selected and K-selected species? (10%)
- 5). Please describe the various types of interrelationships among populations. (10%)

一. 詳述人體面對 stress 的生理反應。(25%)

二. 詳述人體呼吸速率的調控機制。(25%)

三. 詳述人體血壓的調控機制。(25%)

四. 繪圖並詳細說明神經細胞 (Neuron) 其動作電位 (Action potential) 之形成機制。(10%)

何謂 IPSP (Inhibitory postsynaptic potential)。(8%)

何謂 EPSP (Excitatory postsynaptic potential)。(7%)

1. (10%) Explain the following terms :
 - (a) peptide bond
 - (b) glycosidic bond
 - (c) Bohr effect
 - (d) denaturation & renaturation (of protein)
 - (e) Michaelis-Menten equation
2. (5%) Describe the forces (bonds) that function to stabilize the three dimensional structure of protein.
3. (5%) What are ketone bodies ? What is the purpose of ketone-body formation ?
4. (10%) Most plants in the tropics fix CO_2 by a route called the Hatch-Slack or C_4 pathway. Illustrate how this C_4 pathway functions in CO_2 fixation. What is the advantage of C_4 pathway in comparison with the C_3 pathway ?
5. (5%) How do you determine whether a specific inhibitor of an enzyme-catalyzed reaction was a competitive inhibitor ?
6. (5%) What is the role of phosphagen (phosphoarginine, phosphocreatine) in cells ? The concentration of phosphagen is very high in muscle cells (28mM). However, the *E. coli* contains almost no phosphagen. Why ?
7. (10%) Write all the reactions involved in glycolysis (from glucose to pyruvate). Use structural formulas and name the enzymes involved.

5 5
8. (10%) What are the two Mendelian Principles? How can these principles be specifically explained in the meiotic processes?

9. (10%) What is the "Human Genome Project"? What is the progress so far?

10 10
10. (10%) What is PCR? What ingredients and procedures are needed for the event to happen?

11. (5%) What is a lysogen? It is very common to find lysogens in the nature. Are there any advantages to be lysogenic?

15 15
12. (5%) Restriction enzymes are used to cut DNA. Do you have any idea how the enzymes were named with "restriction" in place?

20 20
25 25
30 30
13. (10%) Mini-preparations of plasmid DNA are done with commercially available purification kits nowadays. Supposedly you are in the process of cloning a DNA fragment into pBR322. After transformation, you picked and grew 10 clones to see if the DNA fragment has been inserted. Unfortunately, there was something wrong with numbering and you don't know exactly which one is the clone you want. So, you'll have to repeat the experiment. But there are only 5 mini-prep columns left, how can you use 5 or less columns to identify which is the correct clone?

國立中山大學八十九學年度碩博士班招生考試試題

科目：(選考) 生物統計 海洋資源學系碩士班 共 4 頁 第 1 頁

- 15% 1. 四組白鼠，注射一定濃度之 Danysz 桿菌後，活存老鼠之數目記錄之，測驗各組白鼠生存率，有無顯著差異存在？ $(\alpha=0.05)$

組別	I	II	III	IV	合計
每組鼠數	40	50	60	50	200
活鼠數	10	8	12	10	40

- 15% 2. 去年某農場飼養的牛在屠宰前平均為 380 磅，今年此農場以新飼料飼養同一種牛，屠宰前隨機取出一個有代表性的樣品(50 頭牛)，此 50 頭牛之體重平均(mean)為 390 磅，標準差(standard error)為 35.2 磅。請問餵以新飼料，牛之平均體重是否大於 380 磅？請以統計方法測試並下結論。 $(\alpha=0.05)$

- 10% 3. 一軸承製造商的產品直徑為常態分布，直徑平均為 3.0005，標準差為 0.001，今客戶要求之規格為 3.000 ± 0.002 ，超過規格則須重製或他用，試問在目前的機器設備下，不合格之比例為多少？

4. 以下為一研究氮肥施用量(公斤)與水稻穀收量(公斤)之結果，我們想瞭解在施肥範圍內，每增施 1 公斤氮肥，能獲得多少稻穀收量？

氮肥用量 (X)	0	0.5	1.0	1.5	2.0	2.5
稻穀收量 (Y)	10	18	32	48	55	62

$$\sum X_i = 7.5 \quad \bar{X} = 1.25 \quad \sum Y_i = 225 \quad \bar{Y} = 37.5$$

- 10% a. 假設 $\hat{Y} = B_0 + B_1 X$ ，請以最小平方和法估算 B_0 及 B_1 。
 10% b. 列出變方分析表，並測試 $H_0: B_1 = 0$ $(\alpha=0.05)$
 10% c. 計算 B_1 之 95% 信賴區間(confidence interval)
 5% d. 計算決定係數(coefficient of determination, R^2)
 5% e. 請說明方程式 (\hat{Y}) 一定通過 (\bar{X}, \bar{Y}) 之原因

- 20% 5. 高雄附近有兩條海洋放流管，將工業廢水分別排放至左營及大林附近沿岸水域，請設計一實驗，使用單分類變方分析方法(One Way Analysis of Variance)來探討此兩條海洋放流管對海洋生態環境是否有影響。陳述中請包括實驗生物，採樣方法，每個地點採樣數目，實驗之變數(variable)等，並請列出以此設計進行試驗後，分析其數據時之“變方分析表”，表中應包括變異來源(source of variation)，自由度(degree of freedom)，平方和(sum of square)，均方(mean square)，及 F 值(註：變方分析表中“平方和”，“均方”及“F”只需填入公式，不需計算值，但“自由度”請按實驗設計之內容將數字填入)。

註：各附表中，自由度(degree of freedom, df)若不完全列出，使用時，以最接近之自由度代替即可。

附表 2

Table 2 Percentage points of the *t* distribution

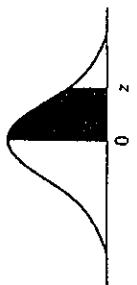


df	a = .10	a = .05	a = .025	a = .010	a = .005
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
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.

附表 1

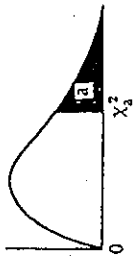
Table 1 Normal curve areas



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	.4988	.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.

Table 3 Percentage points of the chi-square distribution

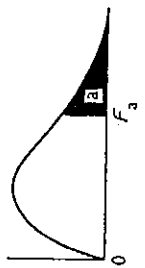


df	a = .995	a = .990	a = .975	a = .950	a = .900	a = .10	a = .05	a = .025	a = .010	a = .005	df
1	0.000393	0.0001571	0.0009821	0.0039321	0.0157908	2.70554	3.84146	5.02389	6.63490	7.87944	1
2	0.0100251	0.0201007	0.0506356	0.102587	0.210720	4.60517	5.99147	7.37776	9.21034	10.5966	2
3	0.0717212	0.114832	0.215795	0.351846	0.584375	6.25139	7.81473	9.34840	11.3449	12.8381	3
4	0.206990	0.297110	0.484419	0.710721	1.063623	7.77944	9.48773	11.1433	13.2767	14.8602	4
5	0.411740	0.554300	0.831211	1.145476	1.61031	9.23635	11.0705	12.8325	15.0863	16.7496	5
6	0.675727	0.872085	1.237347	1.63539	2.20413	10.6446	12.5916	14.4494	16.8119	18.5476	6
7	0.989265	1.239043	1.68987	2.16735	2.83311	12.0170	14.0671	16.0128	18.4753	20.2777	7
8	1.344419	1.646482	2.17973	2.73264	3.48954	13.3616	15.5073	17.5346	20.0902	21.9550	8
9	1.734926	2.087912	2.70039	3.32511	4.16816	14.6837	16.9190	19.0228	21.6660	23.5893	9
10	2.15585	2.55821	3.24697	3.94030	4.86518	15.9871	18.3070	20.4831	23.2093	25.1882	10
11	2.60321	3.05347	3.81575	4.57481	5.57779	17.2750	19.6751	21.9200	24.7250	26.7569	11
12	3.07382	3.57056	4.40379	5.22603	6.30380	18.5494	21.0261	23.3367	26.2170	28.2995	12
13	3.56503	4.10691	5.00874	5.89186	7.04150	19.8119	22.3621	24.7356	27.6883	29.8194	13
14	4.07468	4.66043	5.62872	6.57063	7.78953	21.0642	23.6848	26.1190	29.1413	31.3193	14
15	4.60094	5.22935	6.26214	7.26094	8.54675	22.3072	24.9958	27.4884	30.5779	32.8013	15
16	5.14224	5.81221	6.90766	7.96164	9.31223	23.5418	26.2962	28.8454	31.9999	34.2672	16
17	5.69724	6.40776	7.56418	8.67176	10.0852	24.7690	27.5871	30.1910	33.4087	35.7185	17
18	6.26481	7.01491	8.23075	9.39046	10.8649	25.9894	28.8693	31.5264	34.8053	37.1564	18
19	6.84398	7.63273	8.90655	10.1170	11.6509	27.2036	30.1435	32.8523	36.1908	38.5822	19
20	7.43386	8.26040	9.59083	10.8508	12.4426	28.4120	31.4104	34.1696	37.5662	39.9968	20
21	8.03366	8.89720	10.28293	11.5913	13.2396	29.6151	32.6705	35.4789	38.9321	41.4010	21
22	8.64272	9.54249	10.9823	12.3380	14.0415	30.8133	33.9244	36.7807	40.2894	42.7956	22
23	9.26042	10.19567	11.6885	13.0905	14.8479	32.0069	35.1725	38.0757	41.6384	44.1813	23
24	9.88623	10.8564	12.4011	13.8484	15.6587	33.1963	36.4151	39.3641	42.9798	45.5585	24
25	10.5197	11.5240	13.1197	14.6114	16.4734	34.3816	37.6525	40.6465	44.3141	46.9278	25
26	11.1603	12.1981	13.8439	15.3791	17.2919	35.5631	38.8852	41.9232	45.6417	48.2899	26
27	11.8076	12.8786	14.5753	16.1513	18.1138	36.7412	40.1133	43.1944	46.9630	49.6449	27
28	12.4613	13.5648	15.3079	16.9279	18.9392	37.9159	41.3372	44.4607	48.2782	50.9933	28
29	13.1211	14.2565	16.0471	17.7083	19.7677	39.0875	42.5569	45.7222	49.5879	52.3356	29
30	13.7867	14.9535	16.7908	18.4926	20.5992	40.2560	43.7729	46.9792	50.8922	53.6720	30
40	20.7065	22.1643	24.4331	26.5093	29.0505	51.8050	55.7565	59.3417	63.6907	66.7659	40
50	27.9907	29.7067	32.3574	34.7642	37.5686	63.1671	67.5048	71.4202	76.1539	79.4900	50
60	35.5346	37.4848	40.4817	43.1879	46.4589	74.3970	79.0819	83.2976	88.3794	91.9517	60
70	43.2752	45.4418	48.7576	51.7393	55.3290	85.5271	90.5312	95.0231	100.425	104.215	70
80	51.1720	53.5400	57.1532	60.3915	64.2778	96.5782	101.879	106.629	112.329	116.321	80
90	59.1963	61.7541	65.6466	69.1260	73.2912	107.565	113.145	118.136	124.116	128.299	90
100	67.3276	70.0648	74.2219	77.9295	82.3581	118.498	124.342	129.561	135.807	140.169	100

From "Tables of the Percentage Points of the χ^2 -Distribution," *Biometrika*, Vol. 32 (1941), pp. 188-189, by Catherine M. Thompson. Reproduced by permission of the *Biometrika* Trustees.

MTS 4

Table 4 Percentage points of the F distribution

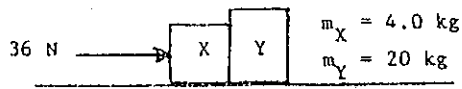


Degrees of freedom		$(\alpha = .05)$																			
df_1	df_2	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞	
1	1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3	
2	1	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50	
3	1	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	8.57	8.55	8.53	
4	1	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	5.69	5.66	5.63	
5	1	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	4.43	4.40	4.36	
6	1	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	3.74	3.70	3.67	
7	1	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	3.30	3.27	3.23	
8	1	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	3.01	2.97	2.93	
9	1	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	2.79	2.75	2.71	
10	1	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	2.62	2.58	2.54	
11	1	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	2.49	2.45	2.40	
12	1	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30	
13	1	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.66	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21	
14	1	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	2.22	2.18	2.13	
15	1	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	2.16	2.11	2.07	
16	1	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	2.11	2.06	2.01	
17	1	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.44	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96	
18	1	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	2.02	1.97	1.92	
19	1	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	1.98	1.93	1.88	
20	1	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	1.95	1.90	1.84	
21	1	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	1.92	1.87	1.81	
22	1	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	1.89	1.84	1.78	
23	1	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	1.86	1.81	1.76	
24	1	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	1.84	1.79	1.73	
25	1	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	1.82	1.77	1.71	
26	1	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	1.80	1.75	1.69	
27	1	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	1.79	1.73	1.67	
28	1	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	1.77	1.71	1.65	
29	1	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	1.75	1.70	1.64	
30	1	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	1.74	1.68	1.62	
40	1	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	1.64	1.58	1.51	
60	1	4.00	3.15	2.76	2.53	2.37	2.26	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39	
120	1	3.92	3.07	2.68	2.45	2.29	2.17	2.08	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25	
∞	1	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	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.

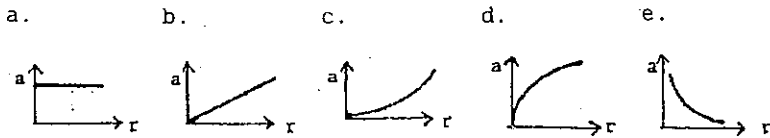
一、選擇題部份，共有十題，每題 5 分。將正確選項寫在答案卷上。

- (1) Two blocks (X and Y) are in contact on a horizontal frictionless surface. A 36 N contact force is applied to X as shown. The force exerted by X on Y is:



- a. 1.5 N
 b. 6.0 N
 c. 29 N
 d. 30 N
 e. 36 N

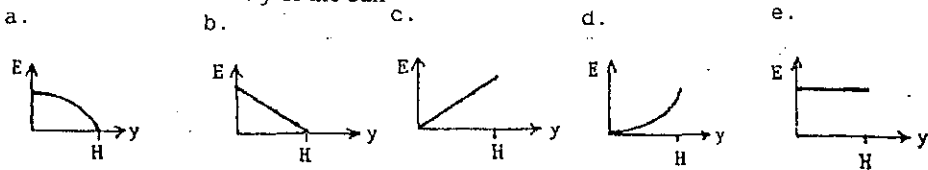
- (2) Which of the following five figures is correct for a particle moving in a circle of radius r at a constant speed of 10 m/s?



- (3) At time $t = 0$ a 2 kg particle has a velocity in m/s of $(4i - 3j)$. At $t = 3$ s its velocity in m/s is $(2i - 3j)$. During this time the work done on it was:

- a. 4 J
 b. -4 J
 c. -12 J
 d. -40 J
 e. $4i + 46j$ J

- (4) A ball is held at a height H above a floor. It is then released and falls to the floor. If air resistance can be ignored which of the five graphs below correctly gives the mechanical energy E of the earth-ball system as a function of the altitude y of the ball?



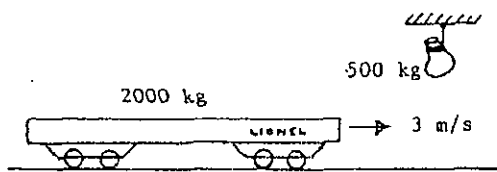
- (5) The intensity of sound wave A is 100 times that of sound wave B. Relative to wave B the sound level of wave A is:

- a. -2 db
 b. +2 db
 c. +10 db
 d. +20 db
 e. +100 db

(6) An organ pipe has length L . Its fundamental frequency is proportional to:

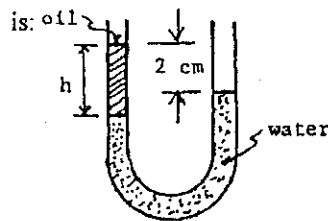
- a. L
- b. $1/L$
- c. $1/L^2$
- d. L^2
- e. \sqrt{L}

(7) A 500 kg sack of coal is dropped on a 2000 kg railroad flatcar which was initially moving at 3 m/s as shown. After the sack rests on the flatcar, the speed of the flatcar is:



- a. 0.6 m/s
- b. 1.2 m/s
- c. 1.8 m/s
- d. 2.4 m/s
- e. 3.6 m/s

(8) The density of oil is 0.08 g/cm^3 . The height h of the column of oil shown



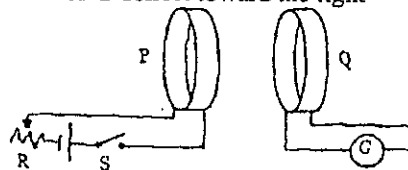
- a. 2 cm
- b. 4.6 cm
- c. 8 cm
- d. 10 cm
- e. 11.8 cm

(9) A large water tank, open at the top, has a small hole in the bottom. When the water level is 30 m above the bottom of the tank, the speed of the water leaking from the hole:

- a. is 2.5 m/s
- b. is 24 m/s
- c. is 44 m/s
- d. cannot be calculated unless the area of the hole is given
- e. cannot be calculated unless the area of the hole and tank are given

(10) Coils P and Q each have a large number of turns of insulated wire. When switch S is closed, the pointer of galvanometer G is deflected toward the left. With S now closed, to make the pointer of G deflect toward the right one could:

- a. open S
- b. move coil P toward coil Q
- c. move coil Q toward coil P
- d. move the slide of the rheostat R quickly to the right
- e. none of the above



二、計算題部份，共 5 題，每題 10 分。

1. A 12 kg mass hangs in equilibrium from a string of total length $L = 5.0$ m and linear mass density $\mu = 0.0010$ kg/m. The string is wrapped around two light, frictionless pulleys that are separated by the distance $d = 2.0$ m as shown in Fig. 1a. (a) Determine the tension in the string. (b) At what frequency must the string between the pulleys vibrate in order to form the standing wave pattern shown in Fig. 1b.

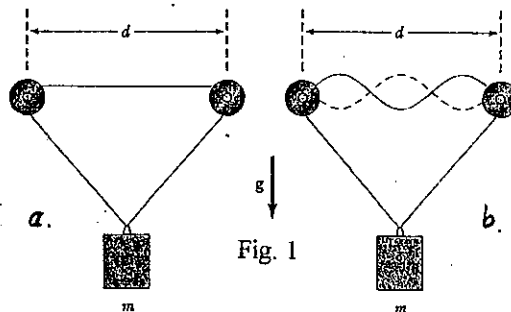


Fig. 1

2. Calculate the potential difference between points a and b in Fig. 2 and identify which point is at the higher potential.

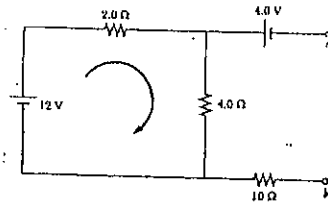


Fig. 2

3. A positive charge $q = 3.2 \times 10^{-19}$ C moves with a velocity $\mathbf{v} = (2\mathbf{i} + 3\mathbf{j} - \mathbf{k})$ m/s through a region where both a uniform magnetic field and uniform electric field exist. (a) Calculate the total force on the moving charge (in unit-vector notation) if $\mathbf{B} = (2\mathbf{i} + 4\mathbf{j} + \mathbf{k})$ T and $\mathbf{E} = (4\mathbf{i} - \mathbf{j} - 2\mathbf{k})$ V/m. (b) What angle does the force vector make with the positive x axis?
4. A string is wound around a uniform disk of radius R and mass M . The disk is released from rest with the string vertical and its top end tied to a fixed support as shown in Fig. 3. As the disk descends, determine (a) the tension in the string, (b) the acceleration of the center of mass. Moment of inertia of the disk is $I = MR^2/2$

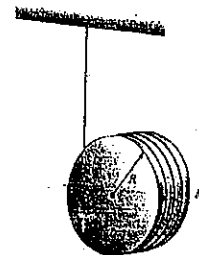


Fig. 3

5. A sinusoidal sound wave is described by the displacement

$$S(x, t) = (2.00 \mu\text{m}) \cos[(15.7 \text{ m}^{-1})x - (858 \text{ s}^{-1})t]$$

- (a) Find the amplitude, wavelength, and speed of this wave.
 (b) Determine the instantaneous displacement of the molecules at the position $x = 0.0500$ m at $t = 3.00$ ms.
 (c) Determine the maximum speed of the molecules' oscillatory motion.

1. 何謂柯氏力效應？其大小是和哪些因素有關？（6分）
2. 全球表面風場是南北相對稱的，試述其分佈概況及其成因？（10分）
3. 海洋表層環流的成因是什麼？以北太平洋為例說明其分佈概況？在赤道地區的流況又是如何？（12分）
4. 解釋聖嬰和反聖嬰現象？它發生的主要地區在那裡？有何影響？（12分）
5. 西方邊界流怎麼形成的？在南北大西洋及南北太平洋分別稱為什麼名字？從流速、寬度、深度、溫度、湧升流和生產力等方面來說明西方邊界流與東方邊界流的不同。（12分）
6. 何謂大潮（spring tide）和小潮（neap tide）？何謂全日潮和半日潮？說明台灣西海岸的潮汐和潮流概況？潮差最大之處在那裡？潮差約多少？（12分）
7. 何謂湧浪（swell）？何謂內波？何謂海嘯波？何謂有義波高？深水波和淺水波的波速如何決定？（12分）
8. 聲速在海水中的大小是隨著那些因素而改變？說明聲速在海洋中的垂直分佈狀況？何謂 Sound channel？（12分）
9. 地衡流（geostrophic current）是什麼？大洋的表層環流一般可視為地衡流，除了直接觀測洋流之外，最常用的方法便是用地衡流的公式來推算洋流，請問這個方法需用到哪些資料，怎麼推算的？（12分）

一. 解釋名詞 (每小題 4 分, 共 20 分)

1. floodplain
2. uniformitarianism
3. mineral
4. weathering
5. metasomatism

二. 簡答題 (每小題 6 分, 共 30 分)

1. 經由什麼樣的地質作用可以使沈積岩轉變成為火成岩?
2. 地震震源 (focus) 的分佈和三種板塊界限的關係為何?
3. 花崗岩 (granite) 和玄武岩 (basalt) 有什麼不同?
4. 有什麼證據可以顯示地球的軟流圈 (asthenosphere) 可能是部份熔融的?
5. 地球表面或靠近地表附近的水之主要儲藏庫 (reservoirs) 在那裏?

三. 問答題 (每小題 10 分, 共 50 分)

1. 如果你是一個從事外星探險的太空人, 請問你如何判斷一個星球 (a) 是否曾經歷分化作用 (differentiation), (b) 是否仍然在地質上是活躍的 (geologically active).
2. 利用那些沈積構造可以判斷沈積岩層的上下層序? 並說明之.
3. (a) 影響塊體運動 (mass wasting) 的因素有那些? (b) 那些因素是發生塊體運動的導火線?
4. 何謂岩漿分化 (magma differentiation)? 試說明其與火成岩種類的關係.
5. 如果板塊地體構造學說 (plate tectonics) 可以解釋如此多的地質現象或地質作用, 為什麼一直到 1960 年代大部份的地質學家才接受這個學說?

(1) 求下列極限 (10%)

(a) $\lim_{x \rightarrow +\infty} (\sqrt{x+\sqrt{x}} - \sqrt{x-\sqrt{x}})$ (5%)

(b) $\lim_{n \rightarrow +\infty} \frac{1}{\sqrt{n}} \sum_{k=1}^n \frac{1}{\sqrt{k}}$ (5%)

(2) 一直徑 8 呎深 10 呎之正圓錐容器 (頂點在下), 每分鐘注入 5 立方呎之水, 試問當水深為 6 呎時, 水面上升之速度為何? (10%)

(3) 令 $g(x) = x(x+5)^{\frac{2}{3}}$

(a) 求 g 之相對極值 (3%)

(b) 求 g 圖形之反曲點 (3%)

(c) 繪製 g 之圖形 (4%)

4. 求下列積分 (30%)

(a) $\int_0^{\frac{\pi}{2}} \frac{dx}{2\cos x + 3}$ (6%)

(b) $\int_0^2 \max\{3x, 4-x^2\} dx$ (6%)

(c) $\int_1^{+\infty} \frac{dx}{x(1+x^2)}$ (6%)

(d) $\int \ln(x^2+1) dx$ (6%)

(e) $\int \sin^2 x \cos^4 x dx$ (6%)

5. 試求由半徑為 2 之二圓柱體垂直相交, 其共同部份之體積. (10%)

6. 判斷下列無窮級數是否收斂或發散 (10%)

(a) $\sum_{n=1}^{\infty} \frac{1}{(n+1) \ln(n+1)}$ (5%)

(b) $\sum_{n=1}^{\infty} \frac{(n-1)!}{n^n}$ (5%)

7. 計算下列積分

$$\iint_{\Omega} \frac{1}{(1+x^2+y^2)^{3/2}} dx dy.$$

其中 $\Omega = \{(x, y) \mid y \leq x, 0 \leq x \leq 1\}$ (10%)

8. 求雙曲面 $x^2 + y^2 - z^2 = 18$ 於點 $(3, 5, -4)$ 之切平面與法線. (10%)

一、選擇題（每小題3分，請將答案寫在答案卷上）

1. 描述穩流、無黏性及不可壓縮狀態下的壓力、速度、高度三者之間關係的公式稱為 ①Euler ②Navier-Stokes ③Bernoulli ④Newton equation
2. Venturi meter（文氏管）可用來測量流體的 ①流量 ②密度 ③黏性 ④加速度
3. 擾流與層流的發生是依據下列何者的大小而決定 ①Mach number ②Reynolds number ③Weber number ④Froude number
4. 自由表面（如波浪）的主要控制參數為 ① Froude number ② Reynolds number ③ Euler number ④ Mach number
5. 皮托管（Pitot tube）是利用什麼原理來量測速度 ①溫度差 ②壓力差 ③葉片轉速 ④加速度差
6. 將流體在圓管內的摩擦係數對 Reynolds number 及管壁粗糙度作圖，稱為 ①Hagen ②Manning ③Moody ④Kelvin chart
7. irrotational flow 的成立條件為 ① $\nabla \cdot \vec{V} = 0$ ② $\nabla \times \vec{V} = 0$ ③ $\frac{d\vec{V}}{dt} = 0$ ④ $\frac{d^2\vec{V}}{dt^2} = 0$
8. 流體的連續方程式指的是 ①質量 ②動量 ③能量 ④渦度 守恒
9. 流函數 ϕ 對 x 和 y 的微分分別等於 ①壓力 ②流速 ③加速度 ④角速度
10. 飛機飛行速度的大小和下列何者相關？ ①Prandtl ② Mach ③Froude ④Reynolds number

二、解釋名詞（每小題6分）

1. gage pressure
2. incompressible flow
3. 邊界層（boundary layer）
4. 水頭損失（head loss）
5. 速度位函數（velocity potential function）
6. 空蝕（cavitation）
7. hydraulic jump

三、一浸沒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。（14分）

四、The water jet in Fig. 1 strikes normal to a fixed plate. Neglect gravity and friction, and compute the force F in newtons required to hold plate fixed. The density of water is 1000 kg/m^3 .（14分）

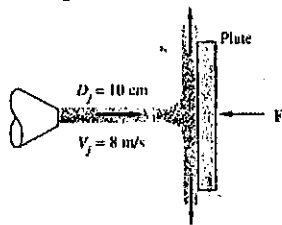


Fig. 1

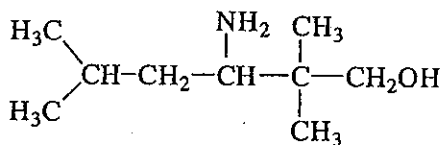
問答題與計算題 (每題 10 分)

- 一. 請寫出七大晶系 (crystal system), 並定義之。
- 二. (a) 何謂晶型 (crystal form)? (b) 特殊晶型 (special form) 和一般晶型 (general form) 有什麼不同? 舉例說明之。
- 三. 試繪圖並說明什麼是氯化鈉 (NaCl) 結構? 其屬於何種型式之晶格 (lattice)?
- 四. (a) 在野外如何鑑定礦物? (b) 在實驗室如何鑑定礦物?
- 五. 試敘述研究礦物學的重要性。
- 六. (a) 何謂解理 (cleavage)? 雲母 (mica) 具有很好的解理, 請問 (b) 其解理如何反映出其內部原子結構?
- 七. 何謂 polymorphism? 試以石英 (quartz) 為例, 舉出並說明石英的各種 polymorphs.
- 八. 在礦物學或結晶學中, (hkl) , $[uvw]$, $\{hkl\}$, $\frac{4}{m}\frac{3}{m}\frac{2}{m}$, 以及 $F432$ 等五個項目分別代表什麼意義。
- 九. 若有兩晶体之點群對稱分別為 (a) $\frac{4}{m}\frac{2}{m}\frac{2}{m}$ 和 (b) $\frac{2}{m}$, 試利用簡繪之赤平投影 (stereo projection) 圖就此二晶体之假想晶面作對稱運作, 在圖上標出其一般晶型 (general form) 之晶面極 (face pole) 位置, 並寫出該晶型和所屬晶系名稱。
- 十. 有一橄欖石 (olivine), 已知其化學成份為 $FeO = 8.58\%$, $MnO = 0.20\%$, $MgO = 50.00\%$, $SiO_2 = 40.99\%$ (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 $Fe = 55.84$, $Mn = 54.94$, $Mg = 24.31$, $O = 16.00$, $Si = 28.08$ 。

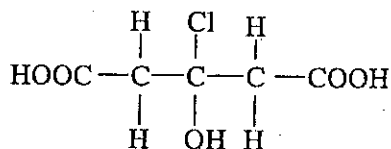
1. Give a specific example of the following name reactions. (12%)

- Wittig reaction
- Baeyer-Villiger rearrangement
- Friedel-Crafts reaction
- Schiff reaction

2. How many magnetically different kinds of protons are there in each of the following compounds? (8%)



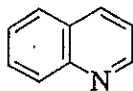
(a)



(b)

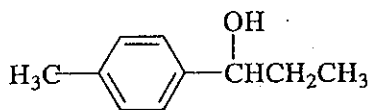
3. Outline reasonable synthetic methods for the following compounds. (10%)

(a)



from aniline and three-carbon compounds

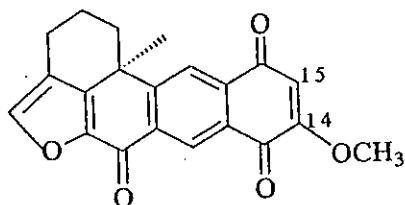
(b)



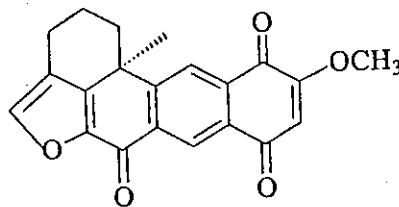
from toluene and any compounds that contain three carbon units or less

4. Describe the theory and application of NMR. (10%)

5. How do you differentiate the following two natural isomers by spectroscopic or physical methods? (10%)



(a)



(b)

5

10

15

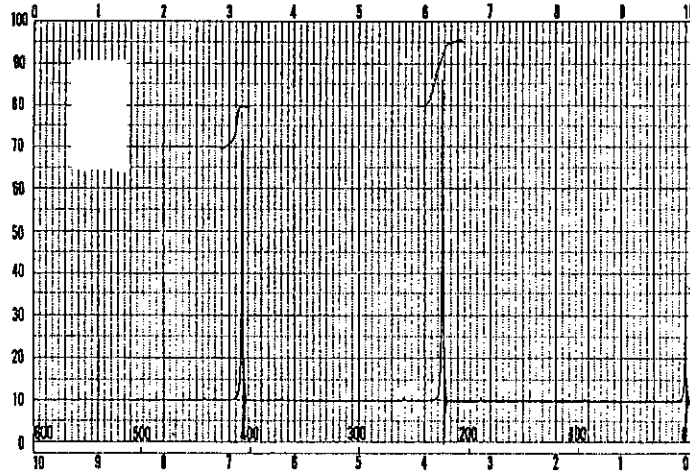
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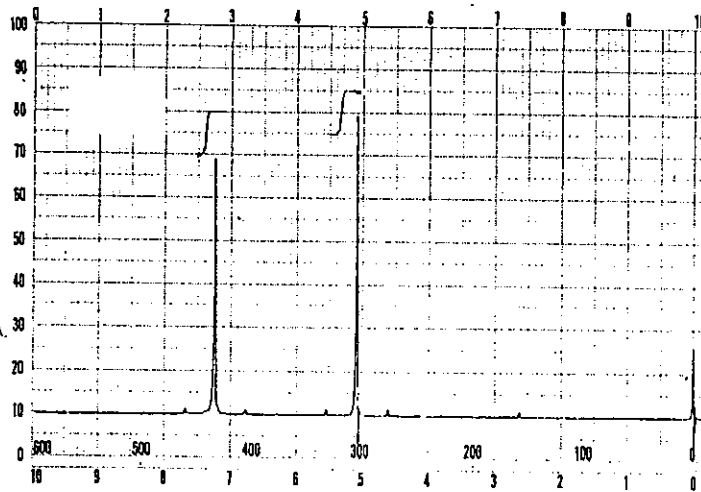
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6. Determine the following chemical structures. (50%)

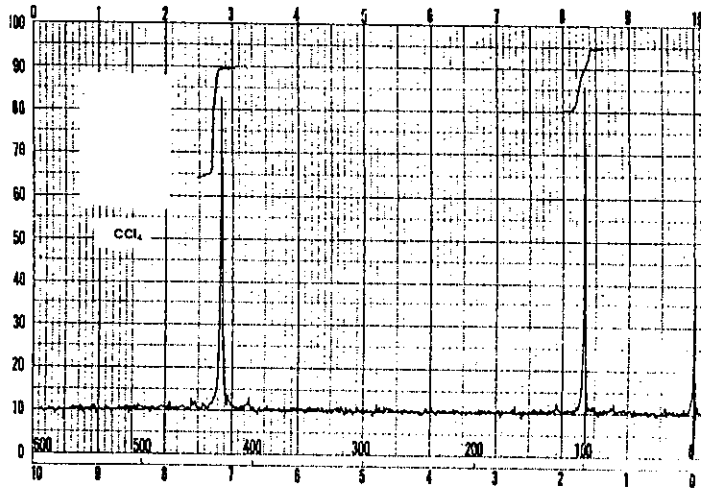
a. $C_8H_{10}O_2$ (5%)



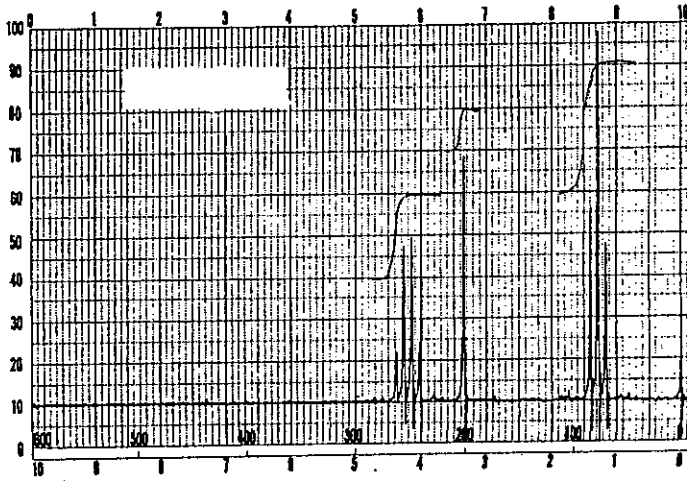
b. C_8H_8O (10%)



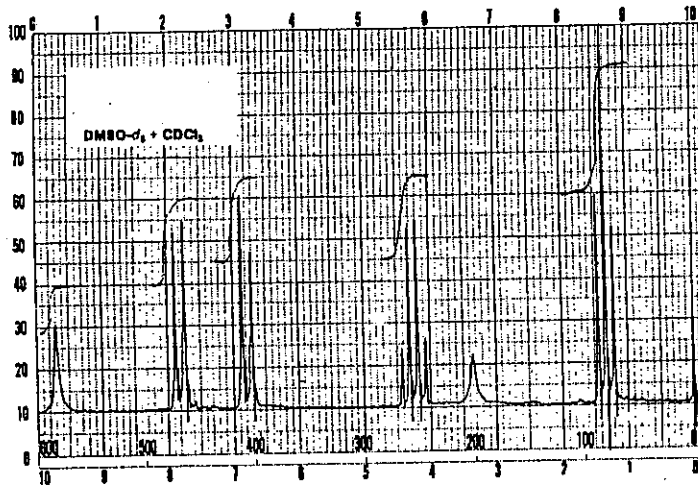
c. $C_{15}H_{16}$ (10%)



- d. An ester ($C_7H_{12}O_4$) was hydrolyzed under alkaline condition to afford an acid ($C_3H_4O_4$). Deduce the structure of the ester. The 1H -NMR spectrum of the ester is given. (10%)



- e. Compound A which had a molecular formula $C_9H_{10}O_3$ was subjected to alkaline hydrolysis to yield compound B ($C_7H_6O_3$). Upon methylation under CH_2N_2 compound A yielded compound C ($C_{10}H_{12}O_3$). What are the structures of A, B and C? The 1H -NMR spectrum of compound A is given. (15%)



國立中山大學八+九學年度碩博士班招生考試試題

科目：分析化學 海洋資源學系碩士班丙

共一頁 第 頁

Note: Be sure to use the correct number of significant figures in the answers of all your calculations!

(10%) 1. If 0.350 L of aqueous solution with a density of 1.00 g/mL contains 13.7 μ g of pesticide A, express the concentration of pesticide A in (a) M and (b) ppm, respectively. (Given: molecular weight of pesticide A = 120.0)

(10%) 2. (a) Define and calculate α_2 for a solution of oxalic acid (H_2Ox) that is buffered to pH 4.00. ($K_1 = 5.36 \times 10^{-2}$; $K_2 = 5.42 \times 10^{-5}$)
(b) Calculate the molar solubility of calcium oxalate in a solution that has been buffered to a constant pH of 4.00. (for $CaOx$, $K_{sp} = 2.30 \times 10^{-9}$)

(10%) 3. (a) What is buffer solution?
(b) What is buffer capacity?
(c) Malonic acid (H_2A) is a weak acid ($K_1 = 1.42 \times 10^{-3}$, $K_2 = 2.01 \times 10^{-6}$). If you are asked to prepare a buffer solution of pH 4.3, will you use malonic acid to prepare this buffer solution? Why or why not?

(10%) 4. For the titration of 50.00 mL of 0.100 M H_2CO_3 with 0.200 M NaOH, calculate the pH after the addition of (a) 20.00 and (b) 40.00 mL of 0.200 M NaOH, respectively. (for H_2CO_3 , $K_1 = 4.45 \times 10^{-7}$, $K_2 = 4.69 \times 10^{-11}$)

(10%) 5. The majority of commercially available FT-IR instruments are based on the Michelson interferometer.

- (a) Briefly define "Fourier Transform".
(b) In comparison with the conventional dispersive IR instrument, what advantages does FT-IR appear to have?
(c) Briefly describe the principle of Michelson interferometer.

(10%) 6. (a) What is cyclic voltammetry?
(b) The three-electrode system is normally used in voltammetry. Name these three electrodes.
(c) Show the schematic diagram of a pH glass-electrode. Please include the necessary components and solutions.

(10%) 7. The following data were obtained by gas chromatography on a 40-cm packed column:

Compound	Retention Time, min	W , min
nonretained	3.1	-
toluene	5.4	0.41
cyclohexene	7.3	1.07

Calculate:

- (a) the number of plates from toluene. (b) the plate height for the column.
(c) the resolution for toluene and cyclohexene. (d) the capacity factor for toluene.

(30%) 8. Define the following terms in detail:

- (a) quadrupole mass spectrometer (b) an ESCA electron.
(c) determinate error (d) fluorescence
(e) PMT (f) monochromator