

1. 詳述如何利用體細胞複製個體。 25%
2. 畫圖並詳述循環系統在動物界的演化。 25%
3. What is the difference between Protostomes and Deuterostomes? 10%
4. What is basal metabolic rate (BMR)? How is it measured? What is the relationship between BMR and size? 10%
5. What is the distinction between an osmoregulator and an osmoconformer? What are the differences among filtration, secretion, and reabsorption? Why are each of these processes important to excretion and osmoregulation? 20%
6. What distinguishes the two basic life history patterns? How could natural selection have shaped these two patterns? 10%

# 國立中山大學95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】

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- 一、何謂 genome? (5分) 何謂 expressed sequence tags (EST)? (5分)
- 二、詳述體液 (body fluid) 影響人體血壓的機制。(30分)
- 三、分別繪圖說明 neuron, cardiac muscle, SA node 產生動作電位 (action potential) 時細胞膜離子通透性的改變狀況。(30分)
- 四、人體面對 stress 時，神經內分泌系統的反應機制為何? (30分)

1. Please described the induced-fit model of enzyme-substrate binding. (10%)
2. What are the differences between “domain” and “motif”. (5%)
3. Please describe the many common features and functions of biomembrane. (10%)
4. How to explored and separated, membrane and cytosolic protein in teleost's cell.  
(15%)
5. Please describe the molecular mechanism of “RNAi”. (10%)
6. What is “post-translational modification”.(5%)
7. Please translate the following message into Chinese. What is the biochemical mechanism of this symptom ? (25%)

Before fatty acids can be degraded in the peroxisome, they must first be transported into the organelle from the cytosol. Mid-length fatty acids are esterified to coenzyme A in the cytosol; the resulting fatty acyl CoAs are then transported into the peroxisome by a specific transporter. However, very long chain fatty acids enter the peroxisome by another transporter and then are esterified to CoA once inside. In the human genetic disease X-linked adrenoleukodystrophy (ALD), peroxisomal oxidation of very long chain fatty acids is specifically defective, while the oxidation of mid-length fatty acids is normal. The most common peroxisomal disorder, ALD is marked by elevated levels of very long chain fatty acids in the plasma and tissues. Patients with the most severe form of ALD are unaffected until mid-childhood, when severe neurological disorders appear, followed by death within a few years. In recent years, the gene that is defective in ALD patients has been identified and cloned by techniques. Sequence analysis shows that the gene encodes an ABC transport protein (ABCD1) that is localized to peroxisomal membranes and is thought to mediate the import of very long chain fatty acids into the organelle.

8. Please describe the specific term (each 5 points)

Proteomics

Lipid rafts

Allosteric effect

Co-factor

## 一、選擇題 (10 %, 單選, 每題 1 分)

- \_\_\_\_\_ 1). Which of the following is *correctly* paired with its description?  
(1). neritic zone - shallow area over continental shelf  
(2). benthic zone - surface water of shallow seas  
(3). pelagic zone - seafloor  
(4). aphotic zone - zone in which light penetrates  
(5). intertidal zone - open water at the edge of the continental shelf
- \_\_\_\_\_ 2). In which are algal blooms most likely to occur?  
(1). headwaters of a stream    (2). downstream area of a river  
(3). lake or pond    (4). intertidal zone of an ocean    (5). benthic zone of an ocean
- \_\_\_\_\_ 3). A population's carrying capacity is  
(1). the number of individuals in the population  
(2). reached when the number of deaths exceeds the number of births  
(3). inversely related to  $r_{max}$   
(4). the population size that can be supported by available resources for the species within the habitat  
(5). set at 8 billion for the human population
- \_\_\_\_\_ 4). The concept of trophic structure of a community emphasizes the  
(1). prevalent form of vegetation,    (2). keystone predator,    (3). effects of coevolution,    (4). feeding relationships within a community,    (5). species richness of the community.
- \_\_\_\_\_ 5). According to the concept of competitive exclusion,  
(1). two species cannot coexist in the same habitat  
(2). extinction or emigration are the only possible results of competitive interactions  
(3). intraspecific competition results in the success of the best adapted individuals  
(4). two species cannot share the same realized niche in a habitat  
(5). resource partitioning will allow a species to utilize all the resources of its fundamental niche
- \_\_\_\_\_ 6). Which of the following statements is *not true* ?  
(1). About 71 percent of the surface of this planet is covered by salt water.  
(2). The average depth of ocean is 3.8 km, giving a volume of  $1370 \times 10^6 \text{ km}^3$ .  
(3). Sea water is slightly alkaline, usually pH ranging from 7.5 to 8.4.  
(4). The oceans are equally distributed over the earth.  
(5). There are organisms living in  $85^\circ\text{C}$  hot springs.

- \_\_\_\_\_ 7). The recent increase in atmospheric CO<sub>2</sub> concentration is mainly a result of an increase in (1). primary productivity, (2). the biosphere's biomass, (3). the absorption of infrared radiation escaping from earth, (4). the burning of fossil fuels and wood, (5). cellular respiration by the exploding human population.
- \_\_\_\_\_ 8). Which of these ecosystem has the lowest primary productivity per square meter? (1). a salt marsh, (2). an open ocean, (3). a coral reef, (4) a grassland, (5). a tropical rain forest.
- \_\_\_\_\_ 9). The return of salmon to their home streams to spawn is an example of (1). olfactory imprinting, (2). Insight, (3). associative learning, (4). operant conditioning, (5). Habituation.
- \_\_\_\_\_ 10). Which level of ecology considers energy flow and chemical cycling? (1) community (2) ecosystem (3) organism (4) population.

二、請詳細解釋下列的生態專有名詞 (40 % , 每題 5 分)

- |                    |                      |
|--------------------|----------------------|
| 1. Tolerance limit | 2. Cline             |
| 3. Age pyramid     | 4. Logistic growth   |
| 5. Niche           | 6. Thermocline       |
| 7. Upwelling       | 8. Hydrothermal vent |

三、問答 (50%)

1. 請舉例說明生態系中的 r-strategist 和 K-strategist 物種的生存策略? (10 %)
2. 臺灣四面環海，擁有許多的海洋環境，請就你所知說明臺灣周邊海域有那些特殊的海洋環境及可開發利用的資源? (20%)
3. 何謂 "聖嬰現象" ? 請詳細說明其發生的原因以及對全球環境的影響? (10 %)
4. 請問水壩的興建對陸域及海域生態系會有那些的衝擊，請以長江三峽大壩為例論述之? (10 %)

1. The following are 11 scores on a biometry test:

82, 75, 47, 69, 58, 68, 57, 78, 93, 83, 65

$$\sum_{i=1}^{11} x_i = 775, \quad \sum_{i=1}^{11} x_i^2 = 56,403$$

a. For the 11 observations above:

- i) Compute the range (4%)
- ii) Compute the mean (4%)
- iii) Compute the median (4%)
- iv) Compute the sample variance (4%)
- v) Compute the sample standard deviation. (4%)

b. What percentage of the 11 observations is actually contained in the interval  $(\bar{x} - s, \bar{x} + s)$ ? (5%)

2. Consider the expressions:  $\hat{I}_1 = \bar{y}_1 + \bar{y}_2 - 2\bar{y}_3$   
 $\hat{I}_2 = \bar{y}_1 + \bar{y}_2 - 2\bar{y}_4$

- a. Are  $\hat{I}_1$  and  $\hat{I}_2$  linear contrasts? (4%)
- b. Are  $\hat{I}_1$  and  $\hat{I}_2$  orthogonal? (4%)

3. Teacher has found that the grades on a final exam are normally distributed with a mean 62 and a standard deviation 12.

- a. If the passing grade is 50, what percent of the class will fail? (4%)
- b. What percent of the class will get scores between 70-85? (4%)
- c. If teacher wants 15% of the class to get A, what grade must a student have in order to get an A. (4%)

4. Plutonium has been produced in Tainan and Kaohsiung counties since the 1980s, and some radioactive wastes have leaked into Erhjen River. A 2005 study of cancer incidence in nearby communities compared an exposure index (X) and the cancer mortality rate per 100,000 residents (Y) for nine villages. Raw data and summary statistics are shown below.

(X) Exposure Index	(Y) Cancer Mortality
8.34	210.3
6.41	177.9
3.41	129.9
3.83	162.3
2.57	130.1
11.64	207.5
1.25	113.5
2.49	147.1
1.62	137.5
$\Sigma X = 41.560$	$\Sigma Y = 1,416.10$
$\Sigma X^2 = 289.422$	$\Sigma Y^2 = 232,498.970$
$\bar{X} = 4.618$	$\bar{Y} = 157.344$
$\Sigma XY = 7,439.37$	

Calculate the following:

- a.  $S_{xy} =$  \_\_\_\_\_ (3%)
- b.  $S_{xx} =$  \_\_\_\_\_ (3%)
- c.  $S_{yy} =$  \_\_\_\_\_ (3%)
- d.  $\hat{\beta}_1 =$  \_\_\_\_\_ (2%)
- e.  $\hat{\beta}_0 =$  \_\_\_\_\_ (2%)
- f. The formula for the least squares regression line is: \_\_\_\_\_ (2%)

g. Complete the ANOVA to test  $H_0: \beta_1 = 0$  and find the F ratio. (8%)


Source of Variation	df	SS	MS	F
SSR	( )	( )	( )	( )
SSE	( )	1375.6	( )	
SST	( )	( )		

h. Find the critical value of the F statistic from the tables, using  $\alpha = 0.05$ , and decide whether to accept or reject  $H_0$ . (2%)

5. 選擇題 (單選, 每題5分, 共30分)


- 1). For a data set with more than 10 observations, if (and only) the largest observation is increased by 10, which of the following quantities will NOT change? (5%)  
 A). sample mean B). median C). variance D). range E). none of the above are true.
- 2). There are 5 statements below, which one is NOT true? (5%)  
 A). sample standard deviation will not change when all the observations of a data set are increased by 10  
 B). according to the Empirical Rule, approximately 99% of the observations should be contained in the interval  $(\bar{x} - 2s, \bar{x} + 2s)$   
 C). the properties of coefficient of variance are independent of the unit of measurement and independent of the magnitude of measurement  
 D). the relation between a statistic and a sample is the same as the relation between a parameter and a population  
 E).  $P(A) + P(A^c) = 1$  and  $(A \cap B)^c = A^c \cup B^c$
- 3). In a statistical test of a hypothesis, how is a Type I error made? (5%)  
 A). by conducting a t-test when  $\sigma^2$  is known.  
 B). by taking too small a sample to reach a conclusion.  
 C). by failing to reject the null hypothesis when in fact the null hypothesis is false.  
 D). by rejecting the null hypothesis when in fact the null hypothesis is true.  
 E). by rejecting the alternative hypothesis when in fact the null hypothesis is false.
- 4). What of the following elements of a statistical test would be affected by changing the significance level  $\alpha$ ? (5%)  
 A). test statistic B). P-value C). null hypothesis D). alternative hypothesis  
 E). none of the above
- 5). If the p-value of a hypothesis test is 0.02, then (5%)  
 A). the null hypothesis will be rejected at 5% level.  
 B). the null hypothesis will not be rejected at 5% level.  
 C). the decision depends on whether it is a two-sided test.  
 D). we don't have enough information to make a decision.
- 6). How many degrees of freedom are associated with a t-test performed on two independent samples? (Where  $n_1$  is the size of the first random sample,  $n_2$  is the size of the second random sample and  $n = n_1 + n_2$ ) (5%)  
 A).  $n_1 + n_2 - 1$  B).  $n - 1$  C).  $n_1 + n_2 - 2$  D).  $n_1 + n_2$   
 E).  $n_1 - 1$  or  $n_2 - 1$ , whichever is larger

Normal Curve Areas



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.00	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.10	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.20	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.30	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.40	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.50	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.60	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.70	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.80	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.90	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.00	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.10	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.20	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.30	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.40	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.50	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.60	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.70	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.80	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.90	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.00	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.10	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.20	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.30	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.40	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.50	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.60	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.70	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.80	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.90	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.00	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Upper-tail Areas for the Normal Curve



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.00	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.10	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.20	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.30	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.40	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.50	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.60	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.70	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.80	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.90	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.00	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.10	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.20	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.30	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.40	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.50	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.60	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.70	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.80	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.90	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.00	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
2.10	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
2.20	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
2.30	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
2.40	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
2.50	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
2.60	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
2.70	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
2.80	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
2.90	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
3.00	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010

TABLE 6 Percentage Points of the F Distribution (df<sub>1</sub> Between 1 and 6)



df <sub>1</sub>	a	1	2	3	4	5	6	7	8	9	10
1	.25	5.83	7.50	8.70	8.58	8.82	8.98	9.10	9.19	9.26	9.32
	.10	39.86	49.50	53.59	55.83	57.24	58.20	58.91	59.44	59.86	60.19
	.05	161.4	199.5	215.7	224.6	230.2	234.0	236.8	239.6	240.5	241.9
	.025	647.8	799.5	864.2	899.6	921.8	937.1	948.2	956.7	963.3	968.6
	.01	4052	5000	5403	5625	5764	5859	5928	5981	6022	6056
2	.25	2.57	3.00	3.15	3.23	3.28	3.31	3.34	3.35	3.37	3.38
	.10	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38	9.39
	.05	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40
	.025	38.51	39.00	39.17	39.25	39.30	39.33	39.36	39.37	39.39	39.40
	.01	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39	99.40
	.005	198.5	199.0	199.2	199.3	199.3	199.3	199.4	199.4	199.4	199.4
	.001	998.5	999.0	999.2	999.2	999.3	999.3	999.4	999.4	999.4	999.4
3	.25	2.02	2.28	2.36	2.39	2.41	2.42	2.43	2.44	2.44	2.44
	.10	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24	5.23
	.05	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79
	.025	17.44	16.04	15.44	15.10	14.88	14.73	14.62	14.54	14.47	14.42
	.01	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	27.23
	.005	55.55	49.80	47.47	46.19	45.39	44.84	44.43	44.13	43.88	43.69
	.001	167.0	148.5	141.1	137.1	134.6	132.8	131.6	130.6	129.9	129.2
4	.25	1.81	2.00	2.05	2.06	2.07	2.08	2.08	2.08	2.08	2.08
	.10	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94	3.92
	.05	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96
	.025	12.22	10.65	9.98	9.60	9.36	9.20	9.07	8.98	8.90	8.84
	.01	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55
	.005	31.33	26.28	24.26	23.15	22.46	21.97	21.62	21.35	21.14	20.97
	.001	74.14	61.25	56.18	53.44	51.71	50.53	49.66	49.00	48.47	48.05
5	.25	1.69	1.85	1.88	1.89	1.89	1.89	1.89	1.89	1.89	1.89
	.10	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32	3.30
	.05	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74
	.025	10.01	8.43	7.76	7.39	7.15	6.98	6.85	6.76	6.68	6.62
	.01	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05
	.005	22.78	18.31	16.53	15.56	14.94	14.51	14.20	13.96	13.77	13.62
	.001	47.18	37.12	33.20	31.09	29.75	28.83	28.16	27.65	27.24	26.92
6	.25	1.62	1.76	1.78	1.79	1.79	1.78	1.78	1.78	1.77	1.77
	.10	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96	2.94
	.05	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06
	.025	8.81	7.26	6.60	6.23	5.99	5.82	5.70	5.60	5.52	5.46
	.01	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87
	.005	18.63	14.54	12.92	12.03	11.46	11.07	10.79	10.57	10.39	10.25
	.001	35.51	27.00	23.70	21.92	20.80	20.03	19.46	19.03	18.69	18.41
7	.25	1.57	1.70	1.72	1.72	1.71	1.71	1.70	1.70	1.69	1.69
	.10	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72	2.70
	.05	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64
	.025	8.07	6.54	5.89	5.52	5.29	5.12	4.99	4.90	4.82	4.76
	.01	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62
	.005	16.24	12.40	10.88	10.05	9.52	9				



## 問答題（第 1~7 題每題 10 分，第 8 與 9 題每題 15 分，共 100 分）

1. (a) 礦物的定義是甚麼？(b) 為什麼礦物學家要對礦物作如此嚴格的定義？(c) 一個來自火星的隕石中所含的磁鐵礦和一個來自鴿子體內的磁鐵礦是否都符合礦物的定義？(10%)
2. 礦物是結晶質的物質，其組成原子或離子藉由鍵結(bonding)來維持特定的晶體架構，(a) 說明礦物常見的鍵結種類，(b) 說明不同的鍵結型式和礦物的物理性質之間的關係(以硬度、熔點、和導電性為例)。(10%)
3. (a) 何謂對稱(symmetry)？(b) 有哪些基本的對稱元素？(c) 對稱元素的組合有什麼限制？(10%)
4. (a) 現行的礦物的分類是根據什麼？試列舉主要的礦物族(classes)。(b) 地殼中含量最豐富的礦物族是哪一族？該族中又以哪三個礦物群(groups)含量最豐富？(10%)
5. (a) 何謂解理(cleavage)？(b) 玉(jade)是輝石或角閃石礦物所組成，這二種礦物皆有很好的解理，但是玉卻因為其良好的硬度與韌度、以及溫潤的色澤等特性，而成為相當貴重的首飾材料，說明為什麼玉具有很好的韌度(tenacity or toughness)。(10%)
6. 說明台灣在以前或現在有些什麼重要的礦產資源？並列舉礦產種類與其大致產地。(10%)
7. 下列符號分別代表什麼意義：(10%)  
(a)  $(hkl)$ , (b)  $\{hkl\}$ , (c)  $[uvw]$ , (d)  $6mm$ , (e)  $I432$
8. (a) 敘述一般量測礦物密度的原理與方法，(b) 測量礦物的密度時，若不考慮量測技術上所導致之誤差，礦物本質上有哪些因素可能會影響測量值？(c) 有一橄欖石晶體其化學成份為  $Fo_4Fa_{96}$  (Fo: fosterite, Fa: fayalite)，另外經由 X-光繞射分析得知其晶室(unit cell)之邊長為  $a_0=4.81 \text{ \AA}$ ,  $b_0=10.56 \text{ \AA}$ ,  $c_0=6.09 \text{ \AA}$ ，試計算此橄欖石之密度(橄欖石為斜方晶系， $Z=4$ ；計算所需要原子量請參考第 9 題)。(d) 此「X-光密度」和其他方法量測值可能會有什麼差異？(15%)

9. 在台灣北部石門水庫附近採集到一種暗青灰色到黑色的岩石，肉眼下觀察是細粒緻密，經偏光顯微鏡下的岩象觀察大致可區分出四種礦物 A、B、C、D：

礦物	體積百分比	晶形	光學性質
A	~35%	subhedral	moderate relief, 干涉色黃、紅、藍，可見一組或兩組解理
B	~50%	subhedral	low relief, 長板狀、干涉色灰白色，可見一組或兩組節理，常可見雙晶
C	~15%	anhedral to euhedral	euhedral 為 pseudomorph, moderate to high relief, 常呈片狀或纖維狀，淺綠色，多色性弱，一組解理，干涉色灰白色至異常藍
D	~5%	anhedral to subhedral	不透光礦物

又經化學分析結果，岩石的化學成份和礦物的化學成份分別如下：

氧化物 (Wt%)	全岩	A	B	C	D	原子量 (O=16)
SiO <sub>2</sub>	51.10	50.98	53.76	27.95	—	28.1
TiO <sub>2</sub>	2.18	2.17	—	0.04	3.08	47.9
Al <sub>2</sub> O <sub>3</sub>	18.55	5.36	28.32	18.24	0.94	27.0
Fe <sub>2</sub> O <sub>3</sub> *	9.28	—	1.07	—	62.31	55.8
FeO**	—	7.92	—	31.97	32.89	55.8
MnO	0.29	—	—	—	0.50	54.9
MgO	3.38	13.27	—	10.34	0.47	24.3
CaO	3.86	20.40	10.37	0.10	—	40.1
Na <sub>2</sub> O	5.70	—	5.09	—	—	23.0
K <sub>2</sub> O	1.75	—	0.51	—	—	39.1
H <sub>2</sub> O	3.91	—	—	—	—	1.0
ToTal	100.00	100.10	99.12	88.68	100.19	

\*成份中之鐵全部以三價鐵計算

\*\*成份中之鐵全部以二價鐵計算

<sup>T</sup>D 礦物成份之二價鐵與三價鐵係經由化學式之計量化學計算所得

(a) 計算出礦物 A 和 B 之化學式 (8%)

(b) 討論觀察與分析並判斷礦物種類和岩石名稱 (7%)

## 一、選擇題（每小題 2 分，共 20 分）

- ( ) 1、恐龍滅絕的時間是在所謂的 K-T boundary 上，這個 boundary 的年代是：  
(A) 250 萬年前 (B) 2500 萬年前 (C) 650 萬年前 (D) 6500 萬年前  
(E) 5 億 7 千萬年前
- ( ) 2、三葉蟲的出現始於寒武紀 (Cambrian)，緊接於寒武紀之前的是地質年代是  
(A) 志留紀 (Silurian) (B) 三疊紀 (Triassic) (C) 元古代 (Proterozoic)  
(D) 古生代 (Paleozoic) (E) 太古代 (Archean)
- ( ) 3、放射性同位素定年的方法中那一種可以用來定冰河的年代？  
(A) 鈾-鉛定年法 (B) 鈷-鉛定年法 (C) 鉀-氬定年法 (D) 鈷-鎳定年法  
(E) 碳-14 定年法
- ( ) 4、以下那一種岩石是屬於非葉理狀岩石？  
(A) 板岩 (B) 頁岩 (C) 角頁岩 (D) 片麻岩 (E) 片岩
- ( ) 5、在地表環境中，下列礦物中那一個是最不安定的？  
(A) 黏土 (B) 鉀長石 (C) 橄欖石 (D) 輝石 (E) 石英
- ( ) 6、以下那一個地區噴發的火山是屬於猛烈噴發型火山？  
(A) 環太平洋火山弧 (B) 中洋脊 (C) 夏威夷群島 (D) 印度德干高原  
(E) 以上皆非
- ( ) 7、花崗岩風化形成黏土礦物的風化作用主要是藉由：  
(A) 氧化作用 (oxidation) (B) 凍裂作用 (frost wedging) (C) 水解作用 (hydrolysis)  
(D) 碳酸鹽化作用 (carbonatization) (E) 生物作用
- ( ) 8、以下的說法何者不正確？  
(A) 猛烈噴發之火山氧化矽的含量低，緩和噴發之火山氧化矽含量高。(B) 矽  
鋁質岩漿比鐵鎂質岩漿要來得黏稠。(C) 岩漿中的氣體愈多，愈有可能噴發出來。  
(D) 黏滯性大的岩漿噴發時通常較黏滯性小的岩漿要來得猛烈。(E) 以上皆非
- ( ) 9、以下哪一種類型的變質作用是屬於 metasomatism 的變質作用？  
(A) 動力熱變質 (B) 熱水變質 (C) 壓碎變質 (D) 深埋變質  
(E) 以上皆非
- ( ) 10、現今各大洋中海洋地殼的年齡最老約為：  
(A) 二百萬年 (B) 二千萬年 (C) 二億年 (D) 二十億年 (E) 以上皆非

## 二、問答題（每小題 10 分，共 80 分）

1. (a) 先說明什麼是板塊（地體）構造循環（tectonic cycle）和岩石循環（rock cycle），(b) 再說明二者之間的關連在哪裡。
2. 風化作用（weathering）和侵蝕作用（erosion）有什麼不同？試說明之。
3. 試比較長石（feldspar）和石英（quartz）：  
(a) 兩者在成份上有什麼差異？(b) 兩者屬於哪一種矽酸鹽結構？(c) 利用礦物的解理性質，如何分辨長石和石英？
4. (a) 何謂岩漿分化（magma differentiation）？(b) 何謂包氏反應系列（Bowen's reaction series）？(c) 此二者間如何關連起來？
5. (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？
6. (a) 何謂葉理（foliation）和節理（joint）？(b) 說明葉理和節理在特性、成因、與形成環境條件上有甚麼不同？
7. (a) 試說明地震的規模（earthquake magnitude）和強度（earthquake intensity）。(b) 1999 年台灣的 921 大地震和 1989 年美國舊金山灣區的大地震在形成機制上有什麼不同？
8. 試說明自流井（artesian well）是如何形成的。

國立中山大學海資研究所九十五學年度碩士班入學考試普通物理試卷

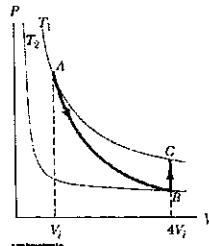
(每題 10 分,共 100 分)

1. In a favorite classroom demonstration as shown in following picture, a student holds the axle of a spinning bicycle wheel while seated on a stool(擱腳凳) that is free to rotate. The student and stool are initially at rest while the wheel is spinning in a horizontal plane with an initial angular momentum  $\vec{L}_i$  that points upward. When the wheel is inverted about its center by  $\pi$ , the student and stool start rotating. In terms of  $\vec{L}_i$ , what are the magnitude and the direction of  $\vec{L}_{\text{student+stool}}$  for the student plus stool?



2. (a) Consider a planet of mass  $M_p$  that is assumed to be moving about the Sun of mass  $M_s$  in a circular orbit with a uniform speed  $v$ . Please find the relation between the planet's period  $T$  and the radius  $a$  of the circular orbit.  
 (b) What is the escape speed  $v_{\text{esc}}$  for an object projected from the surface of a planet with mass  $M$  and radius  $R$ .
3. A wave function on a string is given by  $x(t) = A \sin(kx - \omega t)$ , please find the rate of energy transfer by the sinusoidal wave on string. Hint: the mass per unit length of the string is  $\mu$ , and the wave velocity is  $v$ .  
 (Please express your result with  $\mu, \omega, A, v$ .)

4. For an adiabatic free expansion process of an idea gas indicated by the following picture, suppose that the gas expands to four times its initial volume.
- (a) Using the macroscopic approach, calculate the entropy change  $\Delta S$  for the gas.
- (b) Using statistical consideration, calculate the change in entropy for the gas and show that it agrees with the answer you obtained in part (a).



5. (a) A disk of radius  $R$  has a uniform surface charge density  $\sigma$ . Calculate the electric field  $E$  at a point  $P$  that lies along the central perpendicular axis of the disk and a distance  $x$  from the center of the disk.
- (b) Assume that  $R \gg x$ , find the near-field approximation of the electric field  $E$ .
6. (a) Consider a circular wire loop of radius  $R$  located in the  $yz$  plane and carrying a steady current  $I$ . Calculate the magnetic field  $B$  at an axial point  $P$  a distance  $x$  from the center of the loop.
- (b) When  $x \gg R$ , find the magnetic field  $B$  in terms of the magnetic moment  $\mu$  of the loop.
7. The electric and magnetic fields satisfy the following wave equations

$$\frac{\partial^2 E}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 E}{\partial t^2}, \text{ and } \frac{\partial^2 B}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 B}{\partial t^2},$$

where  $c$  is the speed of light. Please prove the function

$y(x, t) = f(x \pm ct)$  is the general solution of the electric and magnetic fields.

8. A light beam passes from medium 1 to medium 2, with the latter medium being a thick slab of material whose index of refraction is  $n_2$ . Show that the emerging beam is parallel to the incident beam.
9. In the Einstein's special relativity, the total energy  $E$  of a massive particle is given by  $E = K + mc^2 = \frac{mc^2}{\sqrt{1-u^2/c^2}}$ , where  $K$  is the kinetic energy,  $m$  is the invariant mass, and  $u$  is the particle velocity.
- (a) If the total energy of a proton is three times its rest energy, what is the speed of the proton?
- (b) What is the proton's momentum?
10. It was known that the electron's orbital angular momentum about the nucleus is quantized and equal to an integral multiple of  $\hbar = h/2\pi$ ,  $mvr = n\hbar$ ,  $n = 1, 2, 3, \dots$ . The total energy of the hydrogen atom, which consists of the kinetic energy of the electron and the potential energy of the system, can be described by  $E = \frac{1}{2}mv^2 - k\frac{e^2}{r}$ , where  $k$  is a constant.
- (a) Find the orbit of the smallest radius, called the Bohr radius  $a_0$ . (Please express your result with  $\hbar, m, k, e$ ).
- (b) The quantization of orbit radii leads to energy quantization, what is the allowed energy levels (Please express your result with  $k, e, a_0$ )?

一、選擇題，可複選，每題 2 分，共 40 分，答案要寫在答案卷上

1. 假如進入大氣層以前的太陽輻射為 100 單位，則能夠抵達海面的還有幾單位？  
(A) 10 (B) 25 (C) 45 (D) 70 (E) 以上皆非
2. 從海洋損失到大氣的熱量中，佔最大比例的是何者？(A)短波(B)長波(C)傳導顯熱(D)蒸發潛熱
3. 下列何者正確？(A)科氏力在南半球使運動物體朝左偏轉(B)科氏力在南極最小(C)科氏力在赤道最大(D)以上皆非
4. 下列何者錯誤？(A)地轉流在北半球是順時鐘方向(B)壓力梯度力和柯氏力平衡而形成地轉流(C)在北半球面向地轉流下游，高壓在左手方(D)以上皆非
5. 有關 sound channel 的下列何者是正確的？(A)它發生在海面下 100 公尺深(B)它發生在聲速最快之深度(C)潛艇在其中最不易被偵測到(D)它發生在 700~1000 公尺深度(E)以上皆非
6. 聖嬰現象發生時，何者正確？(A)trade wind 加強(B)暖水向東流動(C)祕魯天氣乾旱(D)赤道太平洋的氣壓東高西低(E)以上皆非
7. 下列何者是對的？(A)位溫低於現場水溫(B)水深越大時現場水溫越高(C)位溫可由狀態方程式計算(D)密度和溫度呈線性反比(E)以上皆非
8. 下列何者是錯的？(A)藍光在海水中消光作用最強(B)黑潮為深藍色(C)水色主要是受到海水懸浮質影響(D)可見光波長介於  $0.4\sim 0.75\mu\text{m}$ (E)以上皆對
9. 下列何者正確？(A)  $1\text{ hPa} = 1\text{ mb}$ (B)  $1\text{ atm} = 1013.25\text{ bar}$ (C)一公尺的水柱壓力為一巴(D)一百公尺的水柱壓力為一巴(E)以上皆非
10. 下列何者正確？(A)暖池位於祕魯西方(B)暖池位於新幾內亞以東(C)海面等溫線一般平行於經度線(D)暖池水溫約為  $40^\circ\text{C}$ (E)以上皆非
11. 下列何者正確？(A)科氏力是由地心引力所造成(B)科氏力是由太陽引力所造成(C)靜止物體仍受到科氏力(D)科氏力和物體所在緯度無關(E)以上皆非
12. 下列何者正確？科氏力(A)使得沖馬桶時水會逆時鐘轉(B)使得沖馬桶時水會順時鐘轉(C)是由地心引力所造成(D)是因為地球自轉而形成
13. 下列何者正確？(A)週期 10 秒的深水波波速為  $156\text{ m/s}$ (B)週期 10 秒的深水波波速為  $15.6\text{ m/s}$ (C)水深 10 m 的淺水波波速為  $3.13\text{ m/s}$ (D)水深 10 m 的淺水波波速為  $10\text{ m/s}$
14. 下列何者正確？(A)沿海海域的潮流方向多為垂直於海岸線(B)台灣沿岸潮差最大處為台中港(C)高雄的潮差約為 3 公尺(D)全日潮為一天出現兩次滿潮
15. 下列何者正確？地衡方法(A)等密面和等壓面的傾斜方向相反(B)可算出絕對流速(C)是利用科氏力和摩擦力平衡(D)在北半球面向下游時，重的水在右邊
16. 下列何者正確？湧升流(A)發生在大洋西邊(B)發生在大洋東邊(C)是一種地轉流(D)風向和海岸方向相垂直
17. 下列何者正確？(A)半日潮是一天出現兩次乾潮(B)太陽的引潮力和月球引潮力差不多相等(C)半日潮的週期是 24 小時 50 分(D)月球的引潮力就是對地球的萬有引力



18. 下列何者正確? (A)黑潮帶來冷水(B)黑潮寬度大約 500 km(C)黑潮是一種地轉流(D)黑潮和灣流的成因大不相同
19. 下列何者正確? (A)北半球的高壓是反鐘向(B)南半球的副熱帶環流是反鐘向(C)馬緯度指的是赤道(D)西風帶發生在北極圈
20. 下列何者正確? (A)CTD 是船上測波浪的儀器(B)從海水導電度可換算鹽度(C)衛星高度計可算出洋流大小(D)1 節速度 = 0.5 m/s

二、何謂科氏力參數  $f$ ? 科氏力隨著哪些因素而變? 它如何形成? 指向何方? (10 分)

三、西方邊界流在北大西洋和北太平洋分別指的是什麼洋流? 有何特點? 從 wind stress, friction 和 planetary vorticity 平衡來說明東方和西方邊界流有何不同? (10 分)

四、何謂 Ekman spiral? Ekman transport? 它和沿岸湧升流及赤道湧升流有關係嗎? 解釋之。(10 分)

五、何謂相對渦度, 絕對渦度和位渦度? 若一水柱移動時緯度不變, 但是深度增加, 會有何影響? 若它向南移動, 深度不變, 又有何影響? (10 分)

六、geostrophic flow 是哪兩力相平衡? 在北半球是什麼運動方向? 以黑潮為例, 若你面向著下游, 則海面和等溫線會呈現什麼傾斜方向? 畫出來。(10 分)

七、內波的形成條件和機制是什麼? 和海面波浪相比有何不同特性? (10 分)

# 國立中山大學 95 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. (15分) 求在曲線  $x^5 + x^3y^2 + y^7 = 3$  上, 過  $(1,1)$  點的切線方程式。
2. (20分) 一河寬  $3\text{km}$ , 某甲在  $A$  處欲往對岸  $B$  處 (其中  $A$  與  $B$  之距離為  $5\text{km}$ ), 設  $D$  表甲之上岸處
  - (1) 設甲划船時速  $7$  公里, 步行時速  $8$  公里, 問上岸處  $D$  該距離  $B$  多少公里時, 可使甲最快抵達?
  - (2) 若甲划船時速  $7$  公里, 步行時速  $6$  公里時, 問上岸處  $D$  又該距離  $B$  多少公里時, 可使甲最快抵達?
3. (20分) 請繪出  $y = \sqrt{x^2 + 1} - x + 1$  之圖形, 並繪出遞增、遞減、凹凸與漸近線情形。
4. (15分) 求不定積分  $\int \frac{x+2}{x^3-1} dx$ 。
5. (15分) 求函數  $f(x, y, z) = x^4 + y^4 + z^4$  在曲面  $x^2 + y^2 + z^2 = 1$  上之最大值與最小值。
6. (15分) 求  $\int_0^1 \int_{2y}^2 e^{-\frac{1}{z}} dx dy$

# 國立中山大學 95 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：若涉及計算，請將演算過程列出，否則不予計分

(10%) 1. At 25°C, the solubility product constant,  $K_{sp}$ , for nickel hydroxide,  $\text{Ni}(\text{OH})_2$ , is  $1.6 \times 10^{-14}$ .

- Write a balanced equation for the solubility equilibrium for  $\text{Ni}(\text{OH})_2$ .
- What is the molar solubility of  $\text{Ni}(\text{OH})_2$  in pure water at 25°C ?
- A 1.0-molar NaOH solution is slowly added to a saturated solution of  $\text{Ni}(\text{OH})_2$  at 25°C. If excess solid  $\text{Ni}(\text{OH})_2$  remains in the solution throughout the procedure, what is the concentration of  $\text{Ni}^{2+}$  ions in the solution at the moment when the pH is equal to 11 ?

(10%) 2. An experiment is to be performed involving the titration of a solution of benzoic acid,  $\text{C}_6\text{H}_5\text{COOH}$  of unknown concentration with a standardized 1.00- molar NaOH solution. The  $\text{p}K_a$  of benzoic acid is 4.2.

- What measurements and calculations must be made if the concentration of the acid is to be determined ?
- An indicator must be chosen for the titration. If methyl red (pH interval for color change: 4.2-6.3 ) and thymol blue (pH interval for color change: 8.0-9.6 ) are the only indicators available, which one should be used ? Explain your choice.
- Describe how you would use the titration apparatus and benzoic acid and NaOH solutions to create a buffer solution with a pH of 4.2. (After you had measured the volume of NaOH solution required to reach the equivalence point for a given volume of benzoic acid solution.)

(5%) 3. Experimental error is classified as either systematic or random. Explain the difference between systematic and random errors.

(5%) 4. Indicate how many significant figures there are in each of the following numbers.

- 2.0050
- 0.0100
- 0.0001
- $5.90 \times 10^5$
- $3.20 \times 10^{-3}$

(15%) 5. Explain the following terms of electrochemistry.

- galvanic cell
- salt bridge
- standard hydrogen electrode
- standard reduction potential (  $E^\circ$  )
- Nernst equation

# 國立中山大學 95 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】

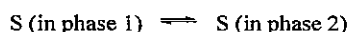
共 2 頁 第 2 頁

(10%) 6. Explain the principle of operation of ion-selective electrodes. What does the selectivity coefficient of ion-selective electrodes tell us? Is it better to have a large or a small selectivity coefficient?

(5%) 7. Why is iodine ( $I_2$ ) almost always used in a solution containing excess  $I^-$ ?

(10%) 8. Explain the difference between transmittance, absorbance, and absorption coefficient in spectrophotometric analyses. Which one is proportional to concentration?

(10%) 9. Solute S has a partition coefficient of 4.0 between water (phase 1) and chloroform (phase 2).



(1) Calculate the concentration of S in chloroform if  $[S_{(aq)}]$  is 0.020 M.

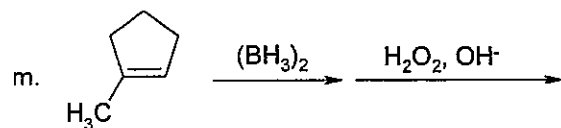
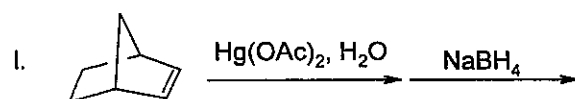
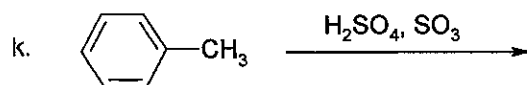
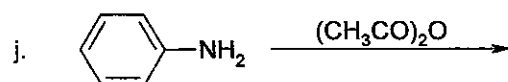
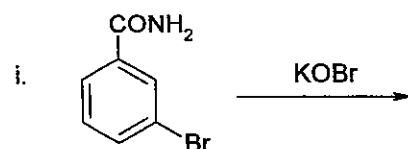
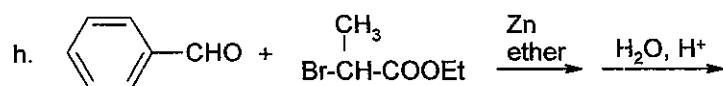
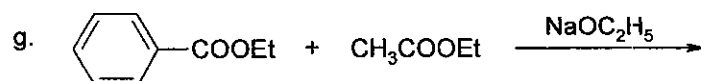
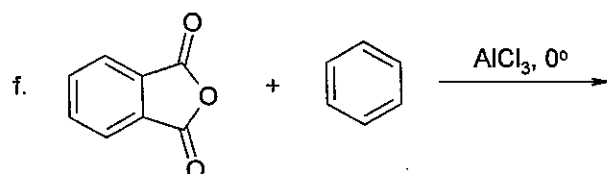
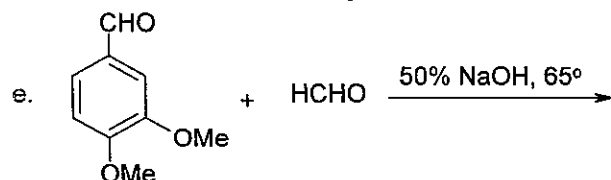
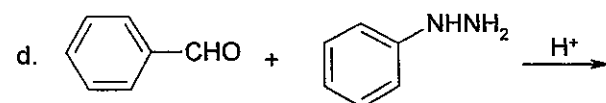
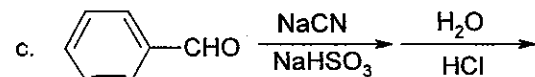
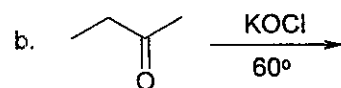
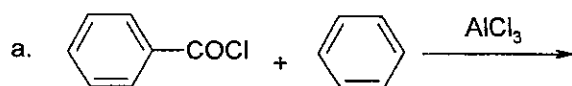
(2) If solute is initially dissolved in 80.0 mL of water, it is then extracted three times with 20.0-mL portions of chloroform. Find the fraction of solute remaining in the aqueous phase.

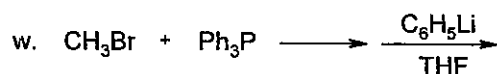
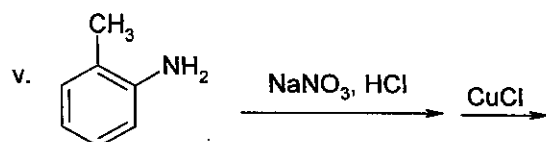
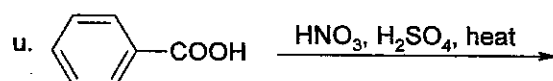
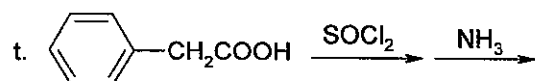
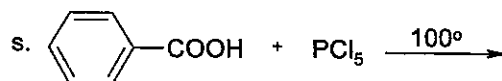
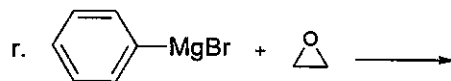
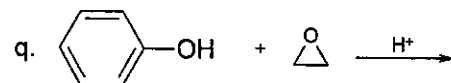
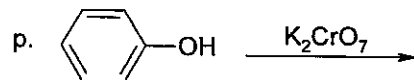
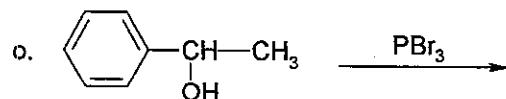
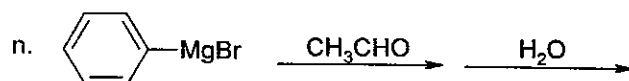
(10%) 10. After the components of a mixture are separated in the gas chromatography column, they must be detected at the outlet so that they can be identified and measured. Explain the principle of the following detectors.

- (1) thermal conductivity detector
- (2) flame ionization detector
- (3) electron capture detector

(10%) 11. Why does the eluent strength increase as solvent becomes less polar in reversed-phase chromatography, whereas the eluent strength increases as solvent becomes more polar in normal-phase chromatography?

1. Give the expected major product(s) for each of the following reactions. (a-v: 3% each; w: 4%)





2. Select a compound that best fits each of the following sets of IR bands (in  $\text{cm}^{-1}$ ). (2% each)

Benzamide, Benzoic acid, Bezonitrile, Biphenyl, Dioxane, Diphenyl sulfone,  
Formic acid, Isobutylamine, 1-Nitropropane

a. 3080 (w), nothing 3000-2800, 2230 (s), 1450 (s), 760 (s), 688 (s)

b. 3380 (m), 3300 (m), nothing 3200-3000, 2980 (s), 2870 (m)

c. 3080 (w), nothing 3000-2800, 1315 (s), 1300 (s), 1155 (s)

d. 2955 (s), 2850 (s), 1120 (s)

e. 2970 (s), 2930 (s), 1600 (s), 1360 (m)

f. 2900 (b,s), 1720 (b, s)

g. 3030 (m), 730 (s), 690 (s)

h. 3200-2400 (s), 1685 (b, s), 705 (s)

i. 3350 (s), 3060 (m), 1635 (s)

3. Match the underlined protons in the following compounds with the correct chemical shift ( $\delta$ ): (2% each)

