



題 1~5 為計算題，題 6~16 為選擇題

1. (5%) A machine breaks down frequently. Whenever a breakdown occurs, one of its 3 different parts needs to be replaced, each with an equal probability. Suppose the machine has been down for 5 times, what is the probability that the machine has replaced all the 3 parts?

2. (10%) Suppose that random variables X and Y have the following joint p.d.f.: $f(x, y) = 8xy$ for $0 < x < y < 1$. What is the correlation coefficient between X and Y ? What does the coefficient measure?

3. (10%) From past experience, 20% of hepatitis (肝炎) patients are type A and the others are type B. There are two test approaches to test whether a hepatitis is type A or B. In test 1, virus of type A has probability 0.6 to show positive reaction and type B virus has probability 0.4 to be positive. In test 2, virus of type A has probability 0.7 to be positive and type B virus has probability 0.5 to be positive.

(a) If the result of test 1 is positive, what is the probability that the patient is type A?

(b) If the result of test 2 is *also* positive, what is the probability that the patient is type A?

4. (10%) Suppose that random variable X has the following p.d.f. $f(x) = x/8$ for $0 \leq x \leq 4$, what is the p.d.f. of X^2 ?

5. (10%) A machine in a manufacturing shop breaks down according to a Poisson process with an average 1.5 breakdowns per month. What is the probability that the *second* breakdown will take place within a month?

Use the following problem to answer questions 6~8.

The number of breakdowns per week for a certain type of minicomputer is a random variable Y having the Poisson distribution with mean λ . A random sample Y_1, Y_2, \dots, Y_n of the observations on the weekly number of breakdowns is available.

6. (5%) Which one is the unbiased estimator for λ ?

(A) Y (B) \bar{Y} (C) $Y - \bar{Y}$ (D) $Y + \bar{Y}$

7. (5%) If the weekly cost of repairing these breakdowns is $C = 3Y + Y^2$, what is $E(C)$?

(A) $3\lambda + \lambda^2$ (B) $\lambda + 3\lambda^2$ (C) $4\lambda + \lambda^2$ (D) $\lambda + 4\lambda^2$



8. (5%) Which one is the unbiased estimator for $E(C)$ in question 7 ?

(A) $3\bar{Y} + \frac{1}{n} \sum_{i=1}^n Y_i^2$ (B) $4\bar{Y} + \frac{1}{n} \sum_{i=1}^n Y_i^2$ (C) $3\bar{Y} + \frac{4}{n} \sum_{i=1}^n Y_i^2$ (D) $4\bar{Y} + \frac{3}{n} \sum_{i=1}^n Y_i^2$

9. (5%) Suppose the random variable Y is an observation from an exponential distribution with mean θ . Which one is the 90% confidence interval for θ ?

(A) $(Y/2.996, Y/0.051)$ (B) $(Y/2.051, Y/0.996)$ (C) $(Y/2.951, Y/0.096)$
 (D) $(Y/2.096, Y/0.951)$

10. (5%) For a comparison of the rates of the defectives produced by two assembly lines, independent random samples of 100 items are selected from each line. Line A yielded 18 defectives in the sample, and line B yielded 12 defectives. Which one is a 98% confidence interval for the true difference in proportions of defectives for the two lines?

(A) $(-0.18, -0.06)$ (B) $(-0.06, 0.18)$ (C) $(-0.18, 0.06)$ (D) $(0.06, 0.18)$

Use the following problem to answer questions 11, 12.

A precision instrument is guaranteed to be accurate to within 2 units. A sample of four instrument readings on the same object yielded the measurements 353, 351, 351, and 355. Test the null hypothesis that $\sigma = 0.7$ against the alternative $\sigma > 0.7$ with $\alpha = 0.05$.

11. (5%) What is the value of the test statistic?

(A) 8.210 (B) 11.729 (C) 22.449 (D) 29.959

12. (5%) What is the critical value of the test?

(A) 7.8147 (B) 9.3484 (C) 9.4877 (D) 11.143

Use the following problem to answer questions 13~15.

After running a multiple regression analysis with five independent variables, the following ANOVA table is obtained.

Source	d.f.	SS	MS	F
Regression	(a)	(c)	(d)	(f)
Residual	(b)	224	(e)	
Total	45	270		

13. (5%) The appropriate hypothesis for the test of significance of regression is:

(A) $H_0: \beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ (B) $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
 (C) $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ (D) $H_0: \beta_1 = \beta_2 = \beta_3 = 0$



14. (5%) What is the value of R^2 ?
(A) 0.83 (B) 0.71 (C) 0.38 (D) 0.17
15. (5%) What is the value of (f) in the ANOVA table?
(A) 1.3348 (B) 2.3348 (C) 3.3348 (D) 4.3348
16. (5%) A company operates four machines three shifts each day. From production records, the following data on the number of breakdowns are collected:

Shift	Machines			
	A	B	C	D
1	41	20	12	16
2	31	11	9	14
3	15	17	16	10

To test the hypothesis that breakdowns are independent of the shift, what is the value of test statistic?

- (A) 0.2367 (B) 0.3627 (C) 0.6372 (D) 0.7632

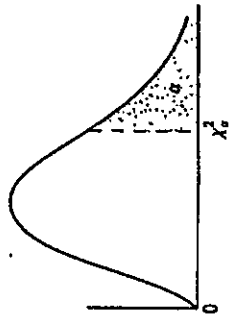


Table A.5 Critical Values of the Chi-Squared Distribution

v	α														
	0.995	0.99	0.98	0.975	0.95	0.90	0.80	0.75	0.75	0.50					
1	0.0093	0.0157	0.0208	0.0282	0.0393	0.0540	0.0763	0.1024	0.1378	0.455					
2	0.0100	0.0201	0.0270	0.0357	0.0484	0.0663	0.0915	0.1219	0.1629	1.386					
3	0.0717	0.115	0.148	0.194	0.263	0.352	0.484	0.637	0.831	2.366					
4	0.207	0.297	0.377	0.457	0.554	0.676	0.831	1.064	1.357	3.357					
5	0.412	0.554	0.676	0.778	0.901	1.064	1.259	1.533	1.876	4.351					
6	0.676	0.872	1.034	1.197	1.385	1.604	1.863	2.204	2.638	5.348					
7	0.989	1.239	1.464	1.690	1.967	2.283	2.642	3.070	3.582	6.346					
8	1.344	1.646	1.922	2.180	2.485	2.833	3.219	3.642	4.151	7.344					
9	1.735	2.088	2.392	2.700	3.025	3.390	3.791	4.233	4.781	8.343					
10	2.156	2.558	2.878	3.201	3.547	3.924	4.333	4.771	5.312	9.342					
11	2.603	3.053	3.386	3.719	4.085	4.474	4.891	5.326	5.858	10.341					
12	3.074	3.571	3.914	4.257	4.641	5.030	5.456	5.891	6.412	11.340					
13	3.565	4.107	4.459	4.809	5.192	5.581	5.999	6.434	6.981	12.340					
14	4.075	4.660	5.012	5.362	5.751	6.139	6.557	6.975	7.551	13.339					
15	4.601	5.229	5.581	5.933	6.314	6.703	7.121	7.559	8.121	14.339					
16	5.142	5.812	6.164	6.516	6.885	7.272	7.690	8.136	8.681	15.338					
17	5.697	6.408	6.760	7.112	7.481	7.851	8.259	8.674	9.241	16.338					
18	6.265	7.015	7.367	7.719	8.091	8.461	8.830	9.203	9.791	17.338					
19	6.844	7.633	7.985	8.341	8.731	9.091	9.460	9.824	10.341	18.338					
20	7.434	8.260	8.612	8.964	9.314	9.664	10.012	10.364	10.891	19.337					
21	8.034	8.897	9.249	9.599	9.949	10.294	10.641	10.991	11.441	20.337					
22	8.643	9.542	9.894	10.241	10.581	10.914	11.264	11.614	12.001	21.337					
23	9.266	10.196	10.548	10.891	11.221	11.544	11.891	12.164	12.564	22.337					
24	9.886	10.856	11.208	11.541	11.871	12.184	12.531	12.831	13.121	23.337					
25	10.520	11.524	11.876	12.221	12.514	12.834	13.191	13.491	13.681	24.337					
26	11.160	12.198	12.550	12.864	13.194	13.514	13.871	14.171	14.271	25.336					
27	11.808	12.879	13.231	13.581	13.914	14.231	14.581	14.881	14.981	26.336					
28	12.461	13.565	13.917	14.264	14.591	14.891	15.241	15.541	15.641	27.336					
29	13.121	14.256	14.608	14.951	15.264	15.564	15.914	16.214	16.314	28.336					
30	13.787	14.953	15.305	15.657	15.964	16.264	16.614	16.914	17.014	29.336					

Table A.5 (continued) Critical Values of the Chi-Squared Distribution

v	α														
	0.30	0.25	0.20	0.10	0.05	0.025	0.02	0.01	0.005	0.001					
1	1.074	1.373	1.642	2.706	3.841	5.024	5.412	6.635	7.879	10.827					
2	2.408	2.773	3.219	4.605	5.991	7.378	7.824	9.210	10.597	13.815					
3	3.665	4.108	4.642	6.251	7.815	9.348	9.837	11.345	12.838	16.268					
4	4.878	5.385	5.989	7.779	9.488	11.143	11.668	13.277	14.860	18.465					
5	6.064	6.626	7.289	9.236	11.070	12.832	13.388	15.086	16.750	20.517					
6	7.231	7.841	8.558	10.645	12.592	14.449	15.033	16.812	18.548	22.457					
7	8.383	9.037	9.803	12.017	14.067	16.013	16.622	18.475	20.278	24.332					
8	9.524	10.219	11.030	13.362	15.507	17.535	18.168	20.090	21.955	26.125					
9	10.656	11.389	12.242	14.684	16.919	19.023	19.679	21.666	23.589	27.877					
10	11.781	12.549	13.442	15.987	18.307	20.483	21.161	23.209	25.188	29.588					
11	12.899	13.701	14.631	17.275	19.675	21.920	22.618	24.725	26.757	31.264					
12	14.011	14.845	15.812	18.549	21.026	23.337	24.054	26.217	28.300	32.909					
13	15.119	15.984	16.985	19.812	22.362	24.736	25.472	27.688	29.819	34.528					
14	16.222	17.117	18.151	21.064	23.685	26.119	26.873	29.141	31.319	36.123					
15	17.322	18.245	19.311	22.307	24.996	27.488	28.259	30.578	32.801	37.697					
16	18.418	19.369	20.465	23.542	26.296	28.845	29.633	32.000	34.267	39.252					
17	19.511	20.489	21.615	24.769	27.587	30.191	30.995	33.409	35.718	40.790					
18	20.601	21.605	22.760	25.989	28.869	31.526	32.346	34.805	37.156	42.312					
19	21.689	22.718	23.900	27.204	30.144	32.852	33.687	36.191	38.582	43.820					
20	22.775	23.828	25.038	28.412	31.410	34.170	35.020	37.566	39.997	45.315					
21	23.858	24.935	26.171	29.615	32.671	35.479	36.343	38.932	41.401	46.797					
22	24.939	26.039	27.301	30.813	33.924	36.781	37.659	40.289	42.796	48.268					
23	26.018	27.141	28.429	32.007	35.172	38.076	38.968	41.638	44.181	49.728					
24	27.096	28.241	29.553	33.196	36.415	39.364	40.270	42.980	45.558	51.179					
25	28.172	29.339	30.675	34.382	37.652	40.646	41.566	44.314	46.928	52.620					
26	29.246	30.434	31.795	35.563	38.885	41.923	42.856	45.642	48.290	54.052					
27	30.319	31.528	32.912	36.741	40.113	43.194	44.140	46.963	49.645	55.476					
28	31.391	32.620	34.027	37.916	41.357	44.461	45.419	48.278	50.993	56.893					
29	32.461	33.711	35.139	39.087	42.557	45.722	46.693	49.588	52.336	58.302					
30	33.530	34.800	36.250	40.256	43.773	46.979	47.962	50.892	53.672	59.703					

Table A.6 (continued) Critical Values of the F-Distribution

$f_{0.05}(v_1, v_2)$

v_2	v_1													∞	
	10	12	15	20	24	30	40	60	120	∞					
1	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3					
2	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50					
3	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53					
4	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63					
5	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36					
6	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67					
7	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23					
8	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93					
9	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71					
10	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54					
11	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40					
12	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30					
13	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21					
14	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13					
15	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07					
16	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01					
17	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96					
18	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92					
19	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88					
20	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84					
21	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81					
22	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78					
23	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76					
24	2.25	2.18	2.11	2.03	1.99	1.94	1.89	1.84	1.79	1.73					
25	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71					
26	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69					
27	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67					
28	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65					
29	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64					
30	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62					
40	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51					
60	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39					
120	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25					
∞	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00					

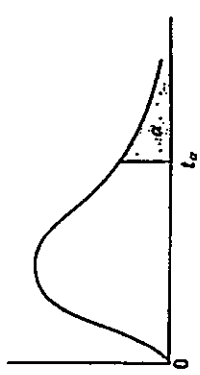


Table A.6* Critical Values of the F-Distribution

$f_{0.05}(v_1, v_2)$

v_2	v_1								
	1	2	3	4	5	6	7	8	9
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88

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Table A.6 (continued) Critical Values of the F-Distribution

$f_{\alpha}(v_1, v_2)$

v_2	v_1								
	1	2	3	4	5	6	7	8	9
1	4052	4999.5	5403	5625	5764	5859	5928	5981	6022
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18
27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12
29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56
∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41

Table A.6 (continued) Critical Values of the F-Distribution

$f_{\alpha}(v_1, v_2)$

v_2	v_1										
	10	12	15	20	24	30	40	60	120	∞	
1	6056	6106	6157	6209	6235	6261	6287	6313	6339	6366	
2	99.40	99.42	99.43	99.45	99.46	99.47	99.47	99.48	99.49	99.50	
3	27.23	27.05	26.87	26.69	26.60	26.50	26.41	26.32	26.22	26.13	
4	14.55	14.37	14.20	14.02	13.93	13.84	13.75	13.65	13.56	13.46	
5	10.05	9.89	9.72	9.55	9.47	9.38	9.29	9.20	9.11	9.02	
6	7.87	7.72	7.56	7.40	7.31	7.23	7.14	7.06	6.97	6.88	
7	6.62	6.47	6.31	6.16	6.07	5.99	5.91	5.82	5.74	5.65	
8	5.81	5.67	5.52	5.36	5.28	5.20	5.12	5.03	4.95	4.86	
9	5.26	5.11	4.96	4.81	4.73	4.65	4.57	4.48	4.40	4.31	
10	4.85	4.71	4.56	4.41	4.33	4.25	4.17	4.08	4.00	3.91	
11	4.54	4.40	4.25	4.10	4.02	3.94	3.86	3.78	3.69	3.60	
12	4.30	4.16	4.01	3.86	3.78	3.70	3.62	3.54	3.45	3.36	
13	4.10	3.96	3.82	3.66	3.59	3.51	3.43	3.34	3.25	3.17	
14	3.94	3.80	3.66	3.51	3.43	3.35	3.27	3.18	3.09	3.00	
15	3.80	3.67	3.52	3.37	3.29	3.21	3.13	3.05	2.96	2.87	
16	3.69	3.55	3.41	3.26	3.18	3.10	3.02	2.93	2.84	2.75	
17	3.59	3.46	3.31	3.16	3.08	3.00	2.92	2.83	2.75	2.65	
18	3.51	3.37	3.23	3.08	3.00	2.92	2.84	2.75	2.66	2.57	
19	3.43	3.30	3.15	3.00	2.92	2.84	2.76	2.67	2.58	2.49	
20	3.37	3.23	3.09	2.94	2.86	2.78	2.69	2.61	2.52	2.42	
21	3.31	3.17	3.03	2.88	2.80	2.72	2.64	2.55	2.46	2.36	
22	3.26	3.12	2.98	2.83	2.75	2.67	2.58	2.50	2.40	2.31	
23	3.21	3.07	2.93	2.78	2.70	2.62	2.54	2.45	2.35	2.26	
24	3.17	3.03	2.89	2.74	2.66	2.58	2.49	2.40	2.31	2.21	
25	3.13	2.99	2.85	2.70	2.62	2.54	2.45	2.36	2.27	2.17	
26	3.09	2.96	2.81	2.66	2.58	2.50	2.42	2.33	2.23	2.13	
27	3.06	2.93	2.78	2.63	2.55	2.47	2.38	2.29	2.20	2.10	
28	3.03	2.90	2.75	2.60	2.52	2.44	2.35	2.26	2.17	2.06	
29	3.00	2.87	2.73	2.57	2.49	2.41	2.33	2.23	2.14	2.03	
30	2.98	2.84	2.70	2.55	2.47	2.39	2.30	2.21	2.11	2.01	
40	2.80	2.66	2.52	2.37	2.29	2.20	2.11	2.02	1.92	1.80	
60	2.63	2.50	2.35	2.20	2.12	2.03	1.94	1.84	1.73	1.60	
120	2.47	2.34	2.19	2.03	1.95	1.86	1.76	1.66	1.53	1.38	
∞	2.32	2.18	2.04	1.88	1.79	1.70	1.59	1.47	1.32	1.00	



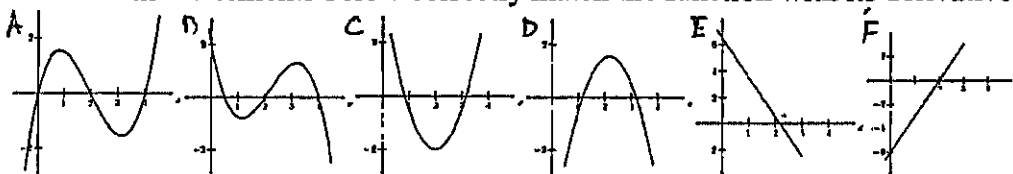
注意：請按照題號及子題號順序作答；不按題號順序作答不以計分。

第一題到第八題每題 5 分；第九題到第十八題每題 6 分。

1. Consider the function $y = x^4 - 2x^3$ for x between -1 and 3 . Which one of the following statements is true?

- (a) There is a global maximum at $(\frac{3}{2}, -\frac{27}{16})$.
- (b) There is a local maximum at $(3, 27)$.
- (c) There is a stationary point of inflection at $(0, 0)$.
- (d) There is a global minimum at $(-1, 3)$.
- (e) There is a local minimum at $(0, 0)$.

2. Which of the statements below correctly match the function with its derivative?



- (a) C is the graph of the derivative of B
F is the graph of the derivative of C
D is the graph of the derivative of A
E is the graph of the derivative of D.
- (b) A is the graph of the derivative of C
C is the graph of the derivative of F
B is the graph of the derivative of D
D is the graph of the derivative of E
- (c) C is the graph of the derivative of A
E is the graph of the derivative of C
D is the graph of the derivative of B
F is the graph of the derivative of D.
- (d) C is the graph of the derivative of A
F is the graph of the derivative of C
D is the graph of the derivative of B
E is the graph of the derivative of D

3. A function f is decreasing for $x \geq 2$ and $f(2) = 20$, $f'(2) = -2$ and $f''(x) > 0$ for $x \geq 2$. Which of the following is a possible value for $f(4)$?

- (a) $f(4) = 16$ (b) $f(4) = 18$ (c) $f(4) = 20$ (d) $f(4) = 22$ (e) $f(4) = 24$

4. Which one of the following statements is correct?

- (a) if $f(t) = 5^t$ then $f'(t) = \frac{1}{\ln 5} 5^t$.
- (b) if $f(x) = x^{-3}$ then $f'(x) = -3x^{-2}$.
- (c) if $f(z) = \frac{1}{z} - \frac{2}{z^2}$ then $f'(z) = 1 - \frac{1}{z}$.
- (d) if $y = x^3 + 3x^2 + 5$ then $\frac{dy}{dx} = 3x^2 + 6x + 5$:
- (e) if $y = \frac{1}{\sqrt{t}}$ then $\frac{dy}{dt} = \frac{-1}{2\sqrt{t}}$.

5. Suppose $f(x, y) = x^3 e^{xy}$ Which one of the following statements is correct?

- (a) $\frac{\partial f}{\partial x} = 3x^2 e^{xy} + x^3 y e^{xy}$ and $\frac{\partial f}{\partial y} = x^4 e^{xy}$.
- (b) $\frac{\partial f}{\partial x} = 3x^3 y e^{xy}$ and $\frac{\partial f}{\partial y} = 3x^3 e^{xy}$.
- (c) $\frac{\partial f}{\partial x} = 3x^2 e^{xy} + x^4 e^{xy}$ and $\frac{\partial f}{\partial y} = x^3 y e^{xy}$.
- (d) $\frac{\partial f}{\partial x} = 3x^2 e^{xy}$ and $\frac{\partial f}{\partial y} = x^3 e^{xy}$.
- (e) $\frac{\partial f}{\partial x} = 3x^2 e^{xy} + x^2 y e^{xy}$ and $\frac{\partial f}{\partial y} = x^4 e^{xy}$.



6. Which one of the following has not been differentiated correctly?
- (a) if $f(t) = e^{x^2+5}$ then $f'(t) = 2xe^{x^2+5}$.
 (b) if $h(x) = \sqrt{x^2+5}$ then $h'(x) = \frac{x}{\sqrt{x^2+5}}$.
 (c) if $f(z) = \frac{1}{(z^2+2z+1)^2}$ then $f'(z) = \frac{3z^2+2}{(z^2+2z+1)^3}$.
 (d) if $h(x) = (2x^4 + e^x)^3$ then $h'(x) = 3(8x^3 + e^x)(2x^4 + e^x)^2$.
 (e) if $y = \sqrt[3]{(2x^2+3x+1)^2}$ then $\frac{dy}{dx} = \frac{2(2x+3)}{3\sqrt[3]{2x^2+3x+1}}$.
7. Which one of the following statements is correct?
- (a) $\lim_{x \rightarrow \infty} \frac{x^2+e^x}{x+e^x} = \infty$ (b) $\lim_{x \rightarrow 1} \frac{1-x}{e^x-e} = -e^{-1}$ (c) $\lim_{x \rightarrow 0} \frac{\sin x^2}{x} = 1$ (d) $\lim_{x \rightarrow 1^-} \frac{\sqrt{1-x^2}}{x-1} = -1$ (e) $\lim_{x \rightarrow 1} \frac{\ln x}{x-1} = 0$
8. Find $\lim_{n \rightarrow \infty} (-1)^n \left(\frac{n+1}{n} \right)$
- (a) 1 (b) -1 (c) ∞ (d) $-\infty$ (e) None of the above
9. Find an expression for the area from 5 to 7 under the curve $y = x^3$ as a limit.
- (a) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(5 + \frac{3i}{n} \right)^3 \frac{4}{n}$.
 (b) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(5 + \frac{4i}{n} \right)^3 \frac{1}{n}$.
 (c) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(5 + \frac{5i}{n} \right)^3 \frac{3}{n}$.
 (d) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(5 + \frac{2i}{n} \right)^3 \frac{2}{n}$.
 (e) $\lim_{n \rightarrow \infty} \sum_{i=1}^n \left(5 + \frac{3i}{n} \right)^3 \frac{3}{n}$.
10. Evaluate the definite integral $\int_{-\pi}^{\pi} \frac{x^2 \sin x}{5+x^6} dx$.
- (a) 0 (b) -2 (c) 0.1 (d) 1 (e) 3
11. Find (approximately) the area of the region bounded by the curves
 $y = 4 + x^2$, $y = 4 + e^{-x^2}$
- (a) $S = 1.01$ (b) $S = 0.96$ (c) $S = 0.98$ (d) $S = 0.99$ (e) $S = 0.97$
12. Evaluate the integral $\int_0^1 x^3 e^{-x^4} dx$.
- (a) $\frac{1}{5}(1-e)$ (b) $\frac{1}{4}(e^{-1}-1)$ (c) $\frac{1}{4}(1-e^{-1})$ (d) $4(1-e^{-1})$ (e) $5(1-e^{-1})$
13. Find $\lim_{x \rightarrow -\infty} x^3 e^x$.
- (a) $-\infty$ (b) 0 (c) 1/3 (d) 3 (e) ∞



14. Evaluate the definite integral $\int \sin^3 2x \cos 2x dx$.

- (a) $-\frac{1}{10} \cos^5 2x + \frac{1}{6} \cos^3 2x + C$.
 (b) $\frac{1}{10} \cos^5 2x - \frac{1}{6} \cos^3 2x + C$.
 (c) $-\frac{1}{10} \sin^5 2x - \frac{1}{6} \sin^3 2x + C$.
 (d) $-\frac{1}{10} \sin^5 2x + \frac{1}{6} \sin^3 2x + C$
 (e) $10 \sin^5 2x + 6 \sin^3 2x + C$

15. Find the solution of the differential equation $x + 4y^3 \sqrt{x^2 + 1} \frac{dx}{dy} = 0$ that satisfies the initial condition $y(0) = 6$.

- (a) $y = \sqrt[4]{1296 + \sqrt{x^2 + 1}}$.
 (b) $y = \sqrt[4]{1297 - \sqrt{x^2 - 1}}$.
 (c) $y = \sqrt[4]{1297 + \sqrt{x^2 + 1}}$.
 (d) $y = \sqrt[4]{1296 - \sqrt{x^2 + 1}}$
 (e) $y = \sqrt[4]{1297 - \sqrt{x^2 + 1}}$

16. Determine whether the series is convergent or divergent. If it is convergent, find its

$$\text{sum. } \sum_{n=1}^{\infty} \frac{4^n + 7^n}{28^n}$$

- (a) divergent (b) $\frac{7}{4}$ (c) $\frac{4}{7}$ (d) $\frac{1}{2}$ (e) $\frac{9}{28}$

17. Find the Maclaurin series of $f(x) = x \cos(2x)$.

- (a) $\sum_{n=0}^{\infty} \frac{(-1)^n 2^n x^{2n+1}}{(2n)!}$.
 (b) $\sum_{n=0}^{\infty} \frac{(-1)^n 2^{2n} x^{2n}}{(2n)!}$.
 (c) $\sum_{n=0}^{\infty} \frac{(-1)^{n+1} 2^n x^{2n+1}}{(2n)!}$
 (d) $\sum_{n=0}^{\infty} \frac{(-1)^n 2^{2n} x^{2n+1}}{(2n)!}$
 (e) $\sum_{n=0}^{\infty} \frac{(-1)^n 2^{2n} x^{2n+1}}{n!}$

18. Calculate the double integral $\iint_R \frac{xy^2}{x^2+1} dA$, $R = \{(x, y) \mid 0 \leq x \leq 4, -3 \leq y \leq 3\}$.

- (a) $7 \ln 5$ (b) $7 \ln 17$ (c) $9 \ln 17$ (d) $9 \ln 5$ (e) $6 \ln 17$



Choose a correct answer for each question. Two points for each question.

1. According to the theory of comparative advantage, specialization and free trade will benefit
(A) all trading parties under certain circumstances.
(B) all trading parties, even when some are absolutely more efficient producers than others.
(C) only that trading party that has an absolute advantage in the production of all goods.
(D) only that trading party that has a comparative advantage in the production of all goods.
2. A change in income, preferences, or prices of other goods or services leads to a _____ that causes a _____.
(A) change in demand; movement along the demand curve
(B) change in quantity demanded; movement along the demand curve
(C) change in demand; shift of the demand curve
(D) change in quantity demanded; shift of the demand curve
3. In college you practically existed on instant noodles, but now you earn \$95,000 a year. You never want to see instant noodles again. We can safely conclude that you consider instant noodles to be a(n)
(A) normal good.
(B) complementary good.
(C) luxury.
(D) inferior good.
4. A decrease in demand for cameras would likely be caused by
(A) an increase in the price of a substitute good.
(B) an increase in the price of cameras.
(C) an increase in the price of a complementary good.
(D) a decrease in the price of cameras.
5. If the market price of rice is \$5.00 per pound but the government will not allow rice farmers to charge more than \$1.00 per pound of rice, which of the following will happen?
(A) Demand must eventually decrease so that the market will come into equilibrium at a price of \$1.50.
(B) There will be a shortage of rice.
(C) Supply must eventually increase so that the market will come into equilibrium at a price of \$1.50.
(D) The market will be in equilibrium at a price of \$1.00.



6. Consumer surplus will be zero at any quantity if
- (A) supply is perfectly elastic.
 - (B) supply is perfectly inelastic.
 - (C) demand is perfectly elastic.
 - (D) demand is perfectly inelastic.
7. At a price of \$11, quantity demanded is 90; and at a price of \$9, quantity demanded is 110. Using the midpoint formula, the price elasticity of demand is
- (A) 0.0.
 - (B) 82.
 - (C) -1.0.
 - (D) -1.22.
8. The government is considering placing a tax on cigarettes to raise revenue to finance health care benefits. One of the arguments for this tax is that the demand for cigarettes is price inelastic. Which of the following statements is TRUE?
- (A) The tax on cigarettes may not raise as much revenue as anticipated in the years to come because the demand for cigarettes is likely to become more elastic over time.
 - (B) This is a very good way to raise revenue both in the short term and in the long term because there are no substitutes for cigarettes.
 - (C) This tax will not raise much revenue either in the short term or the long term because demand is price inelastic.
 - (D) No tax revenue can be raised in this way because sellers of cigarettes will just lower their price by the amount of the tax and therefore the price of cigarettes to consumers will not change.
9. Richard is consuming X and Y so that $MU_x/P_x = 6$ and $MU_y/P_y = 10$. To maximize utility, Richard should
- (A) continue to consume the same amount of X and Y, as the consumer is already maximizing utility.
 - (B) consume less of both X and Y.
 - (C) consume more X and less Y.
 - (D) consume less X and more Y.
10. Assuming that charitable giving is a normal good, the income effect of a decrease in personal tax rates should
- (A) lead to less giving because giving to charity would become more expensive relative to



- other goods.
- (B) lead to more giving because giving to charity would become less expensive relative to other goods.
- (C) lead to more giving because households would have more disposable income.
- (D) lead to less giving because households would spend that money on luxury goods
11. Assume leisure is an inferior good instead of a normal good. The income effect of a wage increase will lead to a _____ demand for leisure and a _____ labor supply.
- (A) lower; higher
- (B) higher; higher
- (C) lower; lower
- (D) higher; lower
12. You own a building that has four possible uses: a cafe, a craft store, a hardware store, and a bookstore. The value of the building in each use is \$2,000; \$3,000; \$4,000; and \$5,000, respectively. You decide to open a hardware store. The opportunity cost of using this building for a hardware store is
- (A) \$2,000, the value if the building is used as a cafe.
- (B) \$3,000, the value if the building is used as a craft store.
- (C) \$10,000, the sum of the values if the building is used for a cafe, a craft store, or a bookstore.
- (D) \$5,000, the value if the building is used for a bookstore.
13. Assume the wool industry is a perfectly competitive industry. The market demand curve for wool is _____ and each individual wool producer's demand curve is _____.
- (A) downward sloping; horizontal
- (B) horizontal; downward sloping
- (C) horizontal; horizontal
- (D) downward sloping; downward sloping
14. If a firm's demand curve is perfectly elastic, then at the profit maximizing level of output
- (A) $P = MR = MC$.
- (B) $P > MR > MC$.
- (C) $P < MR < MC$.
- (D) $P > 0$ and $MR = 0$.
15. Billy Bob's Fertilizer Engineers, a perfectly competitive firm, is incurring a loss but still



- earning an operating profit. Then in the short run this firm should _____ and in the long run, if there is no change in economic conditions, this firm should _____.
- (A) shut down; exit the industry
(B) shut down; expand
(C) produce where $MR = MC$; exit the industry
(D) produce where $MR = MC$; expand
16. Perfect price discrimination
- (A) is charging different prices to different buyers.
(B) is an attempt by monopolists to capture consumer surplus as profit.
(C) can eliminate the deadweight loss to society of a monopoly.
(D) do all of the above.
17. The pizza delivery industry is monopolistically competitive. Little Joe's Pizzeria raises its prices by 10%, but all the other pizzerias in town keep their prices the same. Which of the following is most likely to occur?
- (A) Little Joe's Pizzeria will not be able to sell any pizzas, because it was the only firm to raise its price.
(B) Little Joe's Pizzeria will lose some of its customers.
(C) Little Joe's Pizzeria's profits will increase.
(D) The number of customers served by Little Joe's Pizzeria will increase.
18. If a subsidy is granted to perfectly competitive firms that provide external benefits to society, the firm's marginal cost curve will shift _____ and the industry supply curve will shift to the _____.
- (A) down; left
(B) down; right
(C) up; right
(D) up; left
19. There would be no excess burden from a tax if demand were
- (A) unitarily elastic.
(B) perfectly elastic.
(C) perfectly inelastic.
(D) upward sloping.
20. Which of the following illustrates the principle of second best?
- (A) The government imposes taxes on gasoline and the tax revenue collected is used to pay



- for road repair.
- (B) The government decides to impose taxes on all grains, rather than imposing a tax only on wheat.
- (C) The government imposes a tax on a paper manufacturer that equals the cost of cleaning the river damaged by the waste discharged into the river by the paper manufacturer.
- (D) A tax imposed on land, because this tax distorts economic decisions less than taxes on other factors of production.
21. Suppose that the United States and Italy both produce wine and shoes. In the United States, wine sells for \$10 a bottle and shoes sell for \$40 a pair. In Italy, wine sells for 12,000 lira a bottle and shoes sell for 18,000 lira a pair. If the current exchange rate is 1,000 lira to the dollar, then
- (A) Italy will import both shoes and wine from the United States.
- (B) the United States will import both shoes and wine from Italy.
- (C) the United States will import shoes from Italy and Italy will import wine from the United States.
- (D) the United States will import wine from Italy and Italy will import shoes from the United States.
22. The demand curve faced by a monopolistic competitor is likely to be
- (A) less elastic than the demand curve faced by a perfectly competitive firm and less elastic than the demand curve faced by a monopoly.
- (B) less elastic than the demand curve faced by a perfectly competitive firm and more elastic than the demand curve faced by a monopoly.
- (C) more elastic than the demand curve faced by a perfectly competitive firm and less elastic than the demand curve faced by a monopoly.
- (D) more elastic than the demand curve faced by a perfectly competitive firm and more elastic than the demand curve faced by a monopoly.
23. If a firm's production process exhibits decreasing returns to scale for all levels of output, then the firm's long-run average cost curve will be
- (A) horizontal.
- (B) positively sloped.
- (C) negatively sloped.
- (D) U-shaped.
24. If the competitive firm suddenly notices that price exceeds marginal cost, the firm will
- (A) increase output.



- (B) decrease output.
- (C) be maximizing profits.
- (D) raise its price.

25. Which of the following statements about the short run is TRUE?

- (A) Labor may be the fixed factor.
- (B) In terms of chronological time, it could be as short as two weeks.
- (C) Firms can curtail operations but cannot go completely out of business.
- (D) All of the above

26. Which of the following will cause a rightward shift in the money demand curve?

- A. a reduction in income
- B. an increase in the money supply
- C. a reduction in the interest rate
- D. none of the above

27. Which of the following statements is consistent with a given (i.e., fixed) IS curve?

- A. A reduction in the interest rate causes investment spending to increase.
- B. An increase in government spending causes an increase in demand for goods.
- C. An increase in taxes causes a reduction in demand for goods.
- D. A reduction in the interest rate causes an increase in the money supply.

28. Suppose investment spending is NOT very sensitive to the interest rate. Given this information, we know that:

- A. the LM curve should be relatively steep.
- B. the LM curve should be relatively flat.
- C. the IS curve should be relatively steep.
- D. the IS curve should be relatively flat.

29. Suppose there is a central bank purchase of bonds and simultaneous tax cut. We know with certainty that this combination of policies must cause:

- A. an increase in the interest rate.
- B. a reduction in interest rate.
- C. an increase in output.
- D. a reduction in output.

30. Which of the following will occur if there is a reduction in consumer confidence?

- A. The LM curve will shift up.
- B. The IS curve will shift rightward.
- C. The IS curve will shift leftward.
- D. The LM curve will shift down.



31. Suppose fiscal policy makers implement a policy to reduce the size of a budget deficit. Based on the IS-LM model, we know with certainty that the following will occur in the short run as a result of this fiscal policy action.
- Investment spending will increase.
 - Investment spending will decrease.
 - There will be no change in investment spending.
 - Investment spending may increase, decrease, or not change.
32. Suppose the economy is operating at a point where output is less than the natural level of output. Which of the following statements is correct given this information?
- the price level is less than the expected price level
 - the unemployment rate is less than the natural unemployment rate
 - the price level will be higher next period than this period
 - all of the above
33. Which of the following would reduce the short-run output effects of a monetary expansion?
- The IS curve is very steep
 - a reduction in the interest rate sensitivity of investment
 - a reduction in the marginal propensity to consume
 - all of the above
34. Assume the economy is initially operating at the natural level of output. Now suppose a budget is passed that calls for a tax cut. This fiscal expansion will, in the *medium* run, have no effect on which of the following?
- the price level
 - the interest rate
 - employment
 - all of the above
35. Assume the economy is initially operating at the natural level of output. Suppose that individuals decide to increase their saving. We know that this increased desire to save will be "neutral" in:
- neither the medium run nor the short run.
 - both the short run and the medium run.
 - the short run, but not the medium run.
 - the medium run, but not the long run.
36. For this question, assume that the economy is initially operating at the natural level of output. A reduction in consumer confidence will cause:
- ambiguous effects on the real wage in the medium run.
 - no change in the real wage in the medium run.
 - an increase in the real wage in the medium run.
 - a reduction in the real wage in the medium run.
37. In the aggregate demand relation, a reduction in the price level causes output to increase because of its effect on:
- the expected price level.
 - the interest rate.
 - government spending.
 - firms' markup over labor costs.



38. Assume the economy is initially operating at the natural level of output. Which of the following events will initially cause a shift of the aggregate supply curve?
- an increase in the money supply
 - an increase in consumer confidence
 - an increase in government spending
 - none of the above
39. A reduction in the price of oil will tend to cause which of the following?
- no change in the interest rate in the medium run
 - an increase in investment in the medium run
 - an increase in the aggregate price level as output increases
 - no change in the real wage in the medium run
40. For this question, assume that the expected rate of inflation is a function of past year's inflation. Also assume that the unemployment rate has been equal to the natural rate of unemployment for a number of years. Given this information, we know that:
- the rate of inflation should neither increase nor decrease.
 - the rate of inflation will approximately be equal to zero.
 - the rate of inflation should steadily increase over time.
 - the rate of inflation should steadily decrease.
41. Which of the following would be most likely to cause a change in the natural rate of unemployment?
- changes in monetary policy
 - changes in the rate of inflation
 - changes in the price of oil
 - changes in fiscal policy
42. The "Lucas critique" is that:
- macro data based on government surveys is inaccurate.
 - policy changes affect expectations, which in turn affect the impact of the policy.
 - increasing unemployment to reduce inflation is more costly to society than economists traditionally think.
 - policy changes can affect the economy only when they are expected.
43. For this question, assume that there are decreasing returns to capital, decreasing returns to labor, and constant returns to scale. An increase in the capital stock will cause which of the following?
- not change in output
 - an increase in output per capita
 - a reduction in output
 - decrease the capital-labor ratio
44. Suppose there are two countries that are identical with the following exception. The saving rate in country A is greater than the saving rate in country B. Given this information, we know that in the long run:
- the capital-labor ratios will be the same in both countries.
 - the growth rate of output per capita will be the same in both countries.
 - the growth rate of output per capita will be greater in B than in A.
 - the growth rate of output per capita will be greater in A than in B.
45. "Convergence" has been occurring among the OECD countries because:
- the poorer countries have had higher growth rates than the richer ones.
 - the richer countries give away more of their output than the poorer ones.
 - the richer countries have had higher growth rates than the poorer ones.



- D. the procedures for measuring output per capita have been changing.
46. Suppose a recent budgetary policy results in a reduction in the national saving rate. Such a change in the saving rate will NOT affect which of the following variables in the long run?
- the level of investment
 - output per worker
 - capital per worker
 - none of the above
47. For this question assume that technological progress does not occur. In Japan, the rate of saving has generally been greater than in the U.S. Given this information, we know that in the long run:
- Capital per worker in Japan will be no different than U.S. capital per worker.
 - Japan's growth rate will be greater than the U.S. growth rate.
 - Output per worker in Japan will be greater than U.S. output per worker.
 - all of the above
48. Which of the following represents a dimension of technological progress?
- a larger variety of products
 - new products
 - larger quantities of output for given quantities of capital and labor
 - all of the above
49. Assume that the production function for an economy is represented by the following: $Y = N \cdot A$, where Y denotes the quantity of output, N denotes the number of workers, and A denotes the state of technology. Now assume the economy experiences an increase in productivity (i.e., an increase in A). This increase in productivity will cause:
- the aggregate supply curve to shift downward, and have an ambiguous effect on the aggregate demand curve.
 - the aggregate supply curve to shift downward and the aggregate demand curve to shift leftward.
 - the aggregate supply curve to shift downward and the aggregate demand curve to shift rightward.
 - the aggregate supply curve to shift upward, but has no effect on the aggregate demand curve.
50. Suppose workers' expectations of the price level and productivity are accurate. For this economy, an increase in productivity will cause which of the following?
- a decrease in the real wage and an increase in the natural rate of unemployment
 - an increase in the real wage and a decrease in the natural rate of unemployment
 - an increase in both the real wage and the natural rate of unemployment
 - none of the above