Instructions

Your answers must be entered in your Examination Blue Book; answers on the exam will not be graded. For full credit, you must show complete, correct, legible work. Read carefully before you start working. No books or notes are allowed. Calculators are allowed, but phones, PDAs, music players, Apple watches, and other electronic devices are not.

Solve problem 1, and solve any 13 of the problems 2–16; they are weighted equally. If you solve more than 13 of the problems 2–16, then mark clearly which ones you want graded, otherwise the first 13 answers in your Examination Blue Book will be graded.

Part I

Solve problem 1 and make sure to explain your reasoning.

1. Determine whether the following syllogism is valid or invalid; justify your answer with an Euler diagram.

   Some imports are subject to tariffs
   All computer parts are imported

   Therefore: Some computer parts are subject to tariffs.

Part II

Solve 13 of the problems 2–16 below. If you solve more than 13 problems, then mark clearly which ones you want graded, otherwise the first 13 answers in your Examination Blue Book will be graded.

2. James purchased a bond for $\$3,540$, and 2 years later he sold it for $\$3,700$. To earn the same money on his investment by putting it in a savings account with interest compounded monthly, what annual interest rate would that account have to yield?

3. A committee makes policy decisions affecting adult literacy programs throughout the state. The committee consists of 2 (E)lected official, 3 (L)ibrarians , 2 (T)eachers, and 2 (B)ookstore owners. Assume that each of these four groups votes in a bloc. To make a policy change, a vote of at least 6 is required. Determine the critical voters in the winning coalitions.

4. Assume that among the members of a men's gym, the distribution of body weights is normal with a mean of 188 pounds and a standard deviation of 7. If 267 men belong to the gym, how many of them do you expect to weigh more than 200 pounds?

5. Explain briefly the reasoning behind your answers to questions (a) and (b) below.

   (a) Which of the following estimates is the more reasonable?

   - Between the first day of primary school and college graduation, a typical student spends about 1,500 hours in class rooms.
   - Between the first day of primary school and college graduation, a typical student spends about 15,000 hours in class rooms.
   - Between the first day of primary school and college graduation, a typical student spends about 150,000 hours in class rooms.
   - Between the first day of primary school and college graduation, a typical student spends about 1,500,000 hours in class rooms.

   (b) Which of the following estimates is the more reasonable?

   - Since the introduction in 2007, Apple has sold around one million iPhones.
   - Since the introduction in 2007, Apple has sold around one billion iPhones.
   - Since the introduction in 2007, Apple has sold around one trillion iPhones.

6. Determine whether these statements are logically equivalent:

Drake played Jimmy on Degrassi and Drake started from the bottom

Drake did not play Jimmy on Degrassi or Drake started from the bottom

7. Suppose Lord Stark has a council made up of members from the houses from the North. Suppose he appoints council seats based on the number of people who serve for that house. Assume 200 people serve for House (K)arstark, 87 serve for House (M)ormont, and 139 serve for House (G)lover. Apportion 6 council members among the houses G, K, and M using Hamilton's method.

8. An experiment consists of rolling a pair of standard 6-sided dice and recording the face-up numbers.

   (a) How many outcomes are there in the sample space?

   (b) Write the event E that "the sum of the dice is 4" as a set of outcomes.

   (c) Calculate the probability of E.

9. In a raffle, 5,000 tickets are sold for \$1 each, There is one grand prize of \$2,000 and four consolation prizes of \$300. What are the expected net winnings of a person who purchases one raffle ticket?

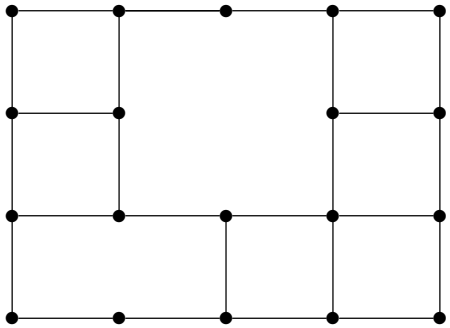
10. The following is a list of the scores that 15 students earned on a 100-point exam:

$$70, 81, 80, 100, 99, 23, 59, 74, 72, 80, 84, 95, 67, 100, 66$$

    (a) Compute the five number summary for the data set.

    (b) Construct a box and whisker plot that represents the data.

11. Consider the graph:



    (a) Find the number of odd vertices.

    (b) Does the graph have an Euler circuit? Why/why not?

    (c) If the answer in (b) is YES, then mark an Euler circuit on the graph. If the answer is NO, then perform an Eulerization of the graph and mark an Euler circuit on the Eulerized graph.

12. You save up for retirement by making yearly deposits of $12,000 into an ordinary annuity. If the annuity has an annual interest rate of 3.5%, how much money will be in the account after 25 years?

13. Consider the following preference table.

Preference	11	7	5
1st	A	B	C
2nd	B	C	B
3rd	C	A	A

    (a) How many voters voted in this election? What is a majority?

    (b) Who wins the election if we use the plurality method?

    (c) If candidate C is removed from the election and the votes are re-counted (still using plurality), who is the winner of the election?

    (d) Explain how this example shows the Independence-of-Irrelevant-Alternatives criterion can be violated.

14. You are buying a house that costs $275,000. You decide to make a $30,000 down payment, and then finance the remaining cost by making monthly payments for 20 years at an annual interest rate of 6%. Use either Table 8.6 or the appropriate formula to calculate your monthly payment amount.

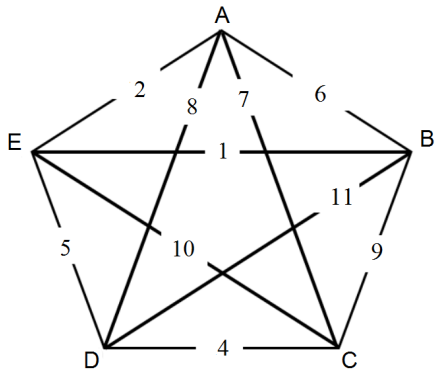
15. The Triwizard Tournament is being held this year, and this time 7 young witches and wizards will be allowed to compete. Hogwarts has 62 eligible students, Durmstrang has 23 eligible students, and Beauxbatons has 55 eligible students.

    (a) Compute the missing Huntington–Hill numbers in the table below.

    (b) Apportion the 7 slots in the turnament using the Huntington–Hill method.

Huntington–Hill Numbers			
Current Number of Participating Students	Hogwarts	Dumstrang	Beauxbatons
1	1992	?	1513
2	?	88	504
3	320	44	?
4	192	26	151
5	128	17	101

16. Consider the graph



(a) Use the Nearest Neighbor algorithm to find a low weight Hamilton circuit. Start at vertex A.

(b) Use the Best Edge algorithm to find a low weight Hamilton circuit.

(c) Of the two circuits you found, which one has the lower weight?

	Number of Years for the Loan				
Annual Interest Rate	**3**	**4**	**10**	**20**	**30**
4%	$29.53	$22.58	$10.12	$6.06	$4.77
5%	29.97	23.03	10.61	6.60	5.37
6%	30.42	23.49	11.10	7.16	6.00
8%	31.34	24.41	12.13	8.36	7.34
10%	32.27	25.36	13.22	9.65	8.78
12%	33.21	26.33	14.35	11.01	10.29

TABLE 8.6 Monthly payments on a $1,000 loan.

Method	How the Winning Candidate Is Determined
Plurality	The candidate receiving the most votes wins.
Borda count	Voters rank all candidates by assigning a set number of points to first choice, second choice, third choice, and so on; the candidate with the most points wins.
Plurality-with-elimination	Successive rounds of elections are held, with the candidate receiving the fewest votes being dropped from the ballot each time, until one candidate receives a majority of votes.
Pairwise comparison	Candidates are compared in pairs, with a point being assigned the voters' preference in each pair. (In the case of a tie, each candidate gets a half point.) After all pairs of candidates have been compared, the candidate receiving the most points wins.

GENERAL RULE FOR COMPUTING $P(F|E)$ If E and F are events in a sample space, then $P(F|E) = \dfrac{P(E \cap F)}{P(E)}$.

HAMILTON'S APPORTIONMENT METHOD

a) Find the standard divisor for the apportionment (total population/total number of representatives).

b) Find the standard quota (state's population/standard divisor) for each state and round it down to its lower quota. Assign that number of representatives to each state.

c) If there are any representatives left over, assign them to states in order according to the size of the fractional parts of the states' standard quotas.

FORMULA FOR FINDING THE FUTURE VALUE OF AN ORDINARY ANNUITY Assume that we are making n regular payments, R, into an ordinary annuity. The interest is being compounded m times a year and deposits are made at the end of each compounding period. The future value (or amount), A, of this annuity at the end of the n periods is given by the equation

$$A = R\frac{\left(1 + \frac{r}{m}\right)^n - 1}{\frac{r}{m}}.$$

COMPUTING FUTURE VALUE USING SIMPLE INTEREST To find the future value of an account that pays simple interest, use the formula

$$A = P(1 + rt),$$

where A is the future value, P is the principal, r is the annual interest rate, and t is the time in years.

DEFINITION Assume that an experiment has outcomes numbered 1 to n with probabilities $P_1, P_2, P_3, \ldots, P_n$. Assume that each outcome has a numerical value associated with it and these are labeled $V_1, V_2, V_3, \ldots, V_n$. The **expected value** of the experiment is

$$(P_1 \cdot V_1) + (P_2 \cdot V_2) + (P_3 \cdot V_3) + \cdots + (P_n \cdot V_n).$$

THE COMPOUND INTEREST FORMULA Assume that an account with principal P is paying an annual interest rate r and compounding is being done m times per year. If the money remains in the account for n time periods, then the future value, A, of the account is given by the formula

$$A = P\left(1 + \frac{r}{m}\right)^n.$$

Notice that in this formula, we have replaced r by $\frac{r}{m}$, which is the annual rate divided by the number of compounding periods per year, and t by n, which is the number of compounding periods.

FORMULA FOR CONVERTING RAW SCORES TO z-SCORES Assume a normal distribution has a mean of μ and a standard deviation of σ. We use the equation

$$z = \frac{x - \mu}{\sigma}$$

to convert a value x in the nonstandard distribution to a z-score.

z	A	z	A	z	A	z	A	z	A	z	A
.00	.000	.56	.212	1.12	.369	1.68	.454	2.24	.488	2.80	.497
.01	.004	.57	.216	1.13	.371	1.69	.455	2.25	.488	2.81	.498
.02	.008	.58	.219	1.14	.373	1.70	.455	2.26	.488	2.82	.498
.03	.012	.59	.222	1.15	.375	1.71	.456	2.27	.488	2.83	.498
.04	.016	.60	.226	1.16	.377	1.72	.457	2.28	.489	2.84	.498
.05	.020	.61	.229	1.17	.379	1.73	.458	2.29	.489	2.85	.498
.06	.024	.62	.232	1.18	.381	1.74	.459	2.30	.489	2.86	.498
.07	.028	.63	.236	1.19	.383	1.75	.460	2.31	.490	2.87	.498
.08	.032	.64	.239	1.20	.385	1.76	.461	2.32	.490	2.88	.498
.09	.036	.65	.242	1.21	.387	1.77	.462	2.33	.490	2.89	.498
.10	.040	.66	.245	1.22	.389	1.78	.463	2.34	.490	2.90	.498
.11	.044	.67	.249	1.23	.391	1.79	.463	2.35	.491	2.91	.498
.12	.048	.68	.252	1.24	.393	1.80	.464	2.36	.491	2.92	.498
.13	.052	.69	.255	1.25	.394	1.81	.465	2.37	.491	2.93	.498
.14	.056	.70	.258	1.26	.396	1.82	.466	2.38	.491	2.94	.498
.15	.060	.71	.261	1.27	.398	1.83	.466	2.39	.492	2.95	.498
.16	.064	.72	.264	1.28	.400	1.84	.467	2.40	.492	2.96	.499
.17	.068	.73	.267	1.29	.402	1.85	.468	2.41	.492	2.97	.499
.18	.071	.74	.270	1.30	.403	1.86	.469	2.42	.492	2.98	.499
.19	.075	.75	.273	1.31	.405	1.87	.469	2.43	.493	2.99	.499
.20	.079	.76	.276	1.32	.407	1.88	.470	2.44	.493	3.00	.499
.21	.083	.77	.279	1.33	.408	1.89	.471	2.45	.493	3.01	.499
.22	.087	.78	.282	1.34	.410	1.90	.471	2.46	.493	3.02	.499
.23	.091	.79	.285	1.35	.412	1.91	.472	2.47	.493	3.03	.499
.24	.095	.80	.288	1.36	.413	1.92	.473	2.48	.493	3.04	.499
.25	.099	.81	.291	1.37	.415	1.93	.473	2.49	.494	3.05	.499
.26	.103	.82	.294	1.38	.416	1.94	.474	2.50	.494	3.06	.499
.27	.106	.83	.297	1.39	.418	1.95	.474	2.51	.494	3.07	.499
.28	.110	.84	.300	1.40	.419	1.96	.475	2.52	.494	3.08	.499
.29	.114	.85	.302	1.41	.421	1.97	.476	2.53	.494	3.09	.499
.30	.118	.86	.305	1.42	.422	1.98	.476	2.54	.495	3.10	.499
.31	.122	.87	.308	1.43	.424	1.99	.477	2.55	.495	3.11	.499
.32	.126	.88	.311	1.44	.425	2.00	.477	2.56	.495	3.12	.499
.33	.129	.89	.313	1.45	.427	2.01	.478	2.57	.495	3.13	.499
.34	.133	.90	.316	1.46	.428	2.02	.478	2.58	.495	3.14	.499
.35	.137	.91	.319	1.47	.429	2.03	.479	2.59	.495	3.15	.499
.36	.141	.92	.321	1.48	.431	2.04	.479	2.60	.495	3.16	.499
.37	.144	.93	.324	1.49	.432	2.05	.480	2.61	.496	3.17	.499
.38	.148	.94	.326	1.50	.433	2.06	.480	2.62	.496	3.18	.499
.39	.152	.95	.329	1.51	.435	2.07	.481	2.63	.496	3.19	.499
.40	.155	.96	.332	1.52	.436	2.08	.481	2.64	.496	3.20	.499
.41	.159	.97	.334	1.53	.437	2.09	.482	2.65	.496	3.21	.499
.42	.163	.98	.337	1.54	.438	2.10	.482	2.66	.496	3.22	.499
.43	.166	.99	.339	1.55	.439	2.11	.483	2.67	.496	3.23	.499
.44	.170	1.00	.341	1.56	.441	2.12	.483	2.68	.496	3.24	.499
.45	.174	1.01	.344	1.57	.442	2.13	.483	2.69	.496	3.25	.499
.46	.177	1.02	.346	1.58	.443	2.14	.484	2.70	.497	3.26	.499
.47	.181	1.03	.349	1.59	.444	2.15	.484	2.71	.497	3.27	.500
.48	.184	1.04	.351	1.60	.445	2.16	.485	2.72	.497	3.28	.500
.49	.188	1.05	.353	1.61	.446	2.17	.485	2.73	.497	3.29	.500
.50	.192	1.06	.355	1.62	.447	2.18	.485	2.74	.497	3.30	.500
.51	.195	1.07	.358	1.63	.449	2.19	.486	2.75	.497	3.31	.500
.52	.199	1.08	.360	1.64	.450	2.20	.486	2.76	.497	3.32	.500
.53	.202	1.09	.362	1.65	.451	2.21	.487	2.77	.497	3.33	.500
.54	.205	1.10	.364	1.66	.452	2.22	.487	2.78	.497		
.55	.209	1.11	.367	1.67	.453	2.23	.487	2.79	.497		