

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 12 of the problems 2–15; they are weighted equally. If you solve more than 12 of the problems 2–15, then mark clearly which ones you want graded, otherwise the first 12 answers in your Examination Blue Book will be graded.

Part I

Solve problem 1 and make sure to explain your reasoning.

1. Determine if the following syllogism is valid or invalid; use either a truth table or an Euler diagram to justify your answer.

If you have an annual gym membership, then you work out at the gym

You do not have an annual gym membership

Therefore: You do not work out at the gym

Part II

Solve 12 of the problems 2–15 below. If you solve more than 12 problems, then mark clearly which ones you want graded, otherwise the first 12 answers in your Examination Blue Book will be graded.

2. You have decided to buy a car in one year and in the meantime you plan to save up \$5,000 for a down payment. To save up the money, you set up an ordinary annuity that pays an annual interest rate of 6%. In order to accumulate the \$5,000 in one year, how much do you need to put into the ordinary annuity each month?
3. The Centers for Disease Control and Prevention has quarantined six people in Atlanta who have come down with a deadly virus. They believe that one person in the group introduced the virus and communicated it to the others, and they hope that no one outside the group has contracted the disease. Use the information in the table below to determine from which one (if any) of the six people the disease could have started and spread to the entire group.

Patient	People who could have contracted the virus from this patient
Frodo	Pippin, Gandalf, Merry
Pippin	Aragorn, Gandalf, Merry
Aragorn	Sam, Merry
Sam	Pippin, Merry
Gandalf	Sam
Merry	Gandalf

4. You recently got a \$500 bonus at work and have decided to invest it into an account. How much will you have in 2 years if the account:
 - (a) has a simple annual interest rate of 10%?
 - (b) has an interest rate of 8%, compounded monthly?
5. The average height of American women of age 18–24 is normally distributed with a mean value of 65.5 inches and a standard deviation of 2.5 inches. What percentage of these women are at least six feet tall?

6. Suppose you roll two (fair, six-sided) dice.
- What is the probability of getting a total of 11?
Use sample spaces, events, and/or outcomes to justify your answer.
 - What are the odds against getting a total of 11?
7. An orchestra is voting on the type of fundraising campaign they want to have to raise money for a trip. The choices are (B)ake Sale, Selling (C)andy Bars, (T)alent Show, or Car (W)ash. The voters' preferences are summarized in the preference table. Use this information to decide what type of campaign will be selected using the plurality-with-elimination method.

Preference	Number of Ballots					
	11	14	16	13	4	7
1st	C	B	C	W	W	T
2nd	W	W	T	B	T	C
3rd	T	T	B	T	C	W
4th	B	C	W	C	B	B

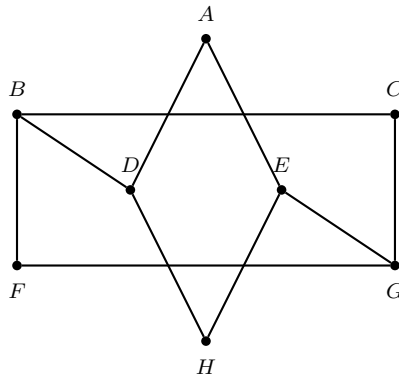
8. A committee is selected to vote yes or no on a proposed location for a new parts distribution center. The committee is composed of three people who live in (A)bbeytown, five people who live in (B)arnsborough, six people who live in (C)hatterville, and eight people who live in (D)itherburgh. At least 17 votes are required for a decision, and the committee members will vote in blocs according to their places of residence. List all winning coalitions and identify the critical members in these coalitions.
9. A city consists of four districts with the following populations:

North : 3,420 South : 8,850 East : 1,760 West : 6,970

Use Hamilton's apportionment method to assign 20 city council seats to the four districts.

10. For a school project, Sue interviewed a total of 100 persons who were either lawyers or salesmen. She asked them if they were happy or unhappy with their occupation. Of the 61 lawyers interviewed, 15 were unhappy, however, only 4 of the salesmen were unhappy. Suppose that one of the persons interviewed is selected at random.
- Find the probability that the person selected is a salesman.
 - Find the probability that the person selected is happy.
 - If we know that the selected person is a lawyer, what is the probability that the person is happy.
11. Construct a truth table for the statement
- $$(q \vee \sim p) \longrightarrow (p \wedge q)$$
12. Adam worked a total of 21 hours last week. One job as a checker in a grocery store paid him \$9 per hour. His other job as a math tutor paid him \$15 per hour. If he earned \$207 between the two jobs, how many hours did he work at each job?

13. Consider the graph



- (a) Which vertices are odd and which are even?
 - (b) How many edges does the graph have?
 - (c) Is the graph connected?
 - (d) Can the graph be traced? Use Euler's Theorem to justify your answer.
14. Suppose that State A has 1,023,948 people and 19 representatives and State B has 782,505 people and 15 representatives.
- (a) Calculate the average constituency for each state.
 - (b) Which state is more poorly represented?
 - (c) Calculate the relative unfairness of this apportionment.
15. The number of goals scored by each team in Major League Soccer during the 2016 regular season are recorded below.

61, 62, 51, 53, 49, 52, 44, 55, 50, 42
50, 39, 54, 55, 42, 44, 48, 45, 32, 39

- (a) Find the mean of the data set.
- (b) Find the median of the data set.

HAMILTON'S APPORTIONMENT METHOD

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

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 $P(F|E) = \frac{P(E \cap F)}{P(E)}$.

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.

RULE FOR COMPUTING THE PROBABILITY OF A UNION OF TWO EVENTS If E and F are events, then

$$P(E \cup F) = P(E) + P(F) - P(E \cap F).$$

If E and F have no outcomes in common, they are called *mutually exclusive events*. In this case, because $E \cap F = \emptyset$, the preceding formula simplifies to

$$P(E \cup F) = P(E) + P(F).$$

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

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.

<i>z</i>	<i>A</i>	<i>z</i>	<i>A</i>	<i>z</i>	<i>A</i>	<i>z</i>	<i>A</i>	<i>z</i>	<i>A</i>	<i>z</i>	<i>A</i>
.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		