QUEENS COLLEGE
DEPARTMENT OF MATHEMATICS
FINAL EXAMINATION
$2\frac{1}{2}$ HOURS

Mathematics 110 **Spring 2019**

Instructions: Answer all questions. Show all work. Box final answers. All answers should be rounded to the nearest hundredth. Good Luck!!

1. The members of Robotics Team 7400 - The ThunderMiners - are voting on their favorite team logo. Their preference rankings are listed below:

Logo	Group of 12	Group of 6	Group of 15	Group of 2	Group of 6	Group of 9
Lightning	1√	1√	3	2	3	2√
Pick Ax	2	3	1√	1√	2√	3
Miner's Cart	3	2√	2√	3	1√	1√

a) Which logo would be selected using the plurality method?
b) Which logo would be selected using the plurality with runoff?
c) Which logo would be selected using Borda's method?
d) Which logo would win the approval vote?
e) Which logo is the Condorcet winner, if any?

2. a) If 1,234 votes are cast in an election that is to be decided by plurality, what is the smallest number of votes with which a candidate can win in a six-candidate race if no ties are allowed?

b) Suppose we are voting on our favorite fairy tale character. There are 200 votes to be cast in an election among four top candidates – Aladdin, Cinderella, Jasmine, and Pocahontas. After the first 180 votes are counted, the tallies are as follows: Aladdin received 45 votes, Cinderella received 25 votes, Jasmine received 58 votes, and Pocahontas received 52 votes. What is the minimal number of remaining votes Aladdin needs to be assured of a win?

3. A generous bystander has donated 250 babysitting hours to families of QC based on the number of kids in their family.

Families	Eric	Rana	Sharon	Valerie
# Kids	19	22	12	5

Apportion the 250 hours based on the number of kids in each family using:
a) Hamilton's method
b) Lowndes' method
c) Webster's method

4. A random sample of the grades on an exam are listed:

56	76	23	84	99	99	86	67	91	85
96	83	99	79	65	57	85	85	92	93

a) Construct a frequency table and histogram with the first exam interval 20-29.
b) Find the sample mean and the sample standard deviation.
c) Find the five-number summary and construct a box-and-whisker plot.

(continued on the back)

5. Seven candidates apply for an internship in the math office. Only three applicants are to be selected.
   a) How many distinct ways can three interns be chosen?
   b) If the tasks are on a first-come, first-served basis, (that is, the first intern will get first choice, and so on), how many ways can the interns be chosen?

6. An experiment has outcomes 1, 2, 4, 5, and 8 with probabilities as shown

$p(x)$	.25	.35	.25	?	.1
x	1	2	4	5	8

   a) Find the missing $p(x)$.
   b) Calculate the mean and standard deviation.
   c) Calculate the probability of having an outcome of at least 5.
   d) Construct the probability histogram.

7. In a standard 52-card deck (2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A with four suits (clubs, diamonds, hearts, and spades)), find the probability that
   a) one card is picked and it is a 2.
   b) a 2 is picked and then without replacement, a face card (J, Q, K) is picked.
   c) a 2 is picked, replaced and then a face card is picked.
   d) an even card is picked and then, without replacement, another even card is picked.
   e) an even card is picked, replaced, and then another even card is picked.

8. The student loans of employees at a company have an approximately normal distribution with $\mu = \$100{,}000$ and $\sigma = \$25{,}000$.
   a) Find the percentage of employees with loans less than $100,000.
   b) Find the percentage of employees with loans between $50,000 and $75,000.
   c) Below what amount is 88.30% of the employees' loans at the company?
   d) If there are 1000 employees at the company, how many employees have loans above $125,000?