1. A lot of national flags are made up of three horizontal stripes.

   a. How many different three color flags (tricolors) can be designed using green, blue, red, yellow and black stripes if all three colours must be different?

   b. How many of them contain a red stripe?

   c. How many extra possibilities are there if the top colour can be the same as the bottom colour?

   3 marks

The flag of Gabon

2. On his university application, Prashad must list his course choices in order of preference.

   He must choose four of the six courses available in his major discipline and three of the four courses offered in related subjects.

   In how many ways can Prashad list his course choices? Explain the reasoning for your answer.

   5 marks

3. Idi is creating a password for a website that has some strict requirements. The password must be 8 characters. Numbers and letters may be used, but may not be repeated.

   a. How many diffferent passwords are possible?

   How many are possible if the following restrictions are enforced;

   b. The password must feature both numbers and letters?

   c. The password must start with a letter?

   d. The password must start with a letter and end with a number?

   8 marks

4. Marissa is doing a Tarot reading in which she must pick 6 cards from a deck of 72. The order of their selection is not important.

   a. How many different readings are possible?

   b. Marissa does not want to see the Fool card. There is one Fool card in the deck. How many of the possible readings do not feature the Fool?

   5 marks

5. A committee of 5 people is to be chosen from a group of 8 women and 10 men.

   a. How many diffferent committees are possible?

   How many are possible if the following restrictions are enforced;

   b. The committee must feature both men and women?

   c. The committee must feature 3 women and two men?

   d. The committee must have more women than men?

   8 marks

6. A baseball team has 14 players.

Baseball at the Summer Olympics

Nate Schierholtz (R) of the US barrells into Chinese catcher Yang Yang (L) to score off a hit by Terry Tiffee in their men's preliminary round baseball game at the Wukesong Baseball Venue during the 2008 Beijing Olympic Games on August 18, 2008. The US won 9-1.

a. How many 9-person batting orders are possible?

b. How many batting orders are possible if Schierholtz is always in the starting line-up and always bats fourth?

4 marks

7. Consider the word MATHEMATICS.

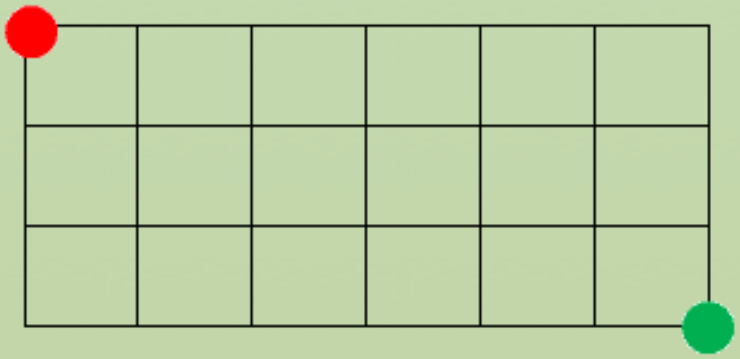
a. How many arrangements are there of the word MATHEMATICS?

b. How many of these start with the letter M?

c. How many of the arrangements in part a have the T's together?

6 marks

8. We have looked at situations in which we need to determine the number of possible routes between two places. We can look at the situation below as 9 steps, six of which must be East and three of which must be South.



This gives us $\frac{9!}{3!6!}$ = 84 possible routes

The calculation $\frac{9!}{3!6!}$ is equivalent to ${}_9C_3$ (or ${}_9C_6$)

Explain clearly why you could solve this question using combinations, and why this is equivalent to considering permutations with repeated items.

4 marks

9. There are 8 parents and 43 students going on a school trip. Two groups are made, a large one with thirty students and five parents, and a small group with 13 students and three parents.

   a. How many different ways can be the parents be chosen for the small group?

   b. How many ways can the students be chosen for the large group if Stefan and Dylan must be in the small group?

   c. How many ways can the groups be arranged if Reena and both her parents must be in the small group?

   6 marks

10. Simplify each expression and write it without using factorial notation.

    a. $\dfrac{(n+4)!}{(n+2)!}$

    b. $\dfrac{(n-r+1)!}{(n-r-2)!}$

    6 marks

11. Investigate a lottery competition somewhere in the world. Explain how the lottery works, and what needs to happen for someone to win the jackpot, and at least one of the minor prizes.

Lottery Balls

Calculate the probability of winning each of the prizes you described, giving a full explanation of your work.

Consider the cost of playing. Do you think the prizes on offer are fair? If not, why not, and why do you think people continue to play?

5 marks

The following questions are to be answered with full solutions. Be sure to focus on proper mathematical form, including:

- One equal sign per line
- Equal signs in each question lined up vertically with each other
- No self-developed short form notation
- One step or idea per line (do not do steps in your head that are not written down; each line must represent a step-by-step progression from question to answer)

Please include neat, complete solutions showing all the steps you used to get your final answer. Be sure your graphs are well labeled, and your curves each easily distinguished with colour coding if you have more than one curve on a grid.

1. During a recent survey of ethnic backgrounds of 1000 people in a large city, 513 were Canada, 148 were French 72 were African and 56 were Asian and the remainder were from other groups.

Calculate the probability that a person, selected at random from the population has:

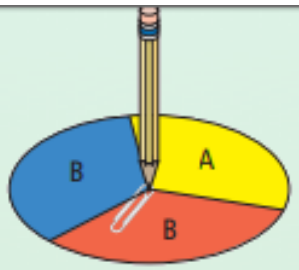
a. a Canadian background?

b. an African background?

c. an "other" background?

6 marks

2. A spinner is divided into three equally sized regions as shown. The spinner is spun twice. For each probability you determine, express your answer as a fraction, decimal and percent.



A Spinner

   a. What is the probability of spinning A on the first spin?

   b. Draw a tree diagram to represent the sample space for both spins.

   c. What is the probability of spinning A followed by B?

   d. What is the probability of getting the same letter on both spins?

   6 marks

3. We have looked in detail at three probability distributions;

   - binomial
   - geometric
   - hypergeometric

   For each one,

   i. Explain the conditions in which we would use it.

   ii. Justify the formula used.

   iii. Give an example of a situation in which it could be used.

   8 marks

4. Two standard six-sided dice are rolled. One die is blue and the other is red.

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a. Create a table to represent the sample space

b. For each probability below, express the answer as a fraction, as a decimal, and as a percentage.

   i. What is the probability of rolling a sum greater than ten?

   ii. What is the probability that the number on the red die is one larger than the number on the blue die?

   iii. What is the probability that the sum of the two numbers is less then 11?

8 marks

5. Use a tree diagram to explain why the probability that a family with four children has either all four children of the same gender is 1/8. Assume that the probability of having a girl is equal to the probability of having a boy.

   3 marks

6. In a library box, there are 8 novels, 8 biographies and 8 war history books.

   If Jack selects two books at random, what is the probability that the two books are of different types?

   3 marks

7. The probability that Prasha will score above a 90 on a mathematics test is 4/5. What is the probability that she will score above a 90 on exactly 3 of the 4 tests this quarter?

   4 marks

8. A company manufacturing laptops believes that 5% of their computers are faulty. They take a sample of 30 computers. Showing your calculations, find the probability;

   a. Two of the laptops are faulty.

   b. More than two of the laptops are faulty.

   4 marks

9. There are six cats and seven dogs in the local animal shelter. Four animals are chosen at random to visit a local school to educate the children on the great need for homes for these animals.

A friendly dog and cat

a. What is the probability that exactly two of the animals are cats?

b. What is the probability that at least one cat is chosen?

6 marks

10. A certain hockey player scores on 18% of his shots.


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a. What is the probability he will score for the first time on his fifth shot?

b. What is the probability that it will take him fewer than 3 shots to score?

c. How many shots should he expect to take before scoring?

6 marks

11. In a multiple choice quiz, there are 6 questions. Each question has 5 possible answers. A student guesses at each question.

a. Find the probability that the student gets 4 answers correct.

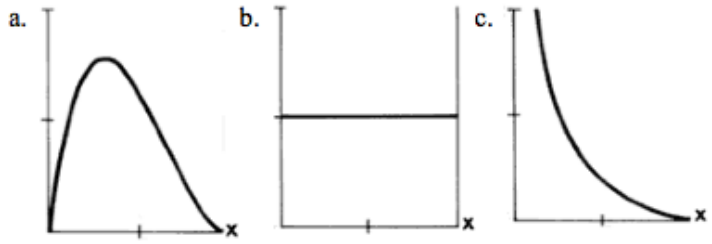
b. Find the probability that the student passes (ie gets at least 50%)

c. What is the student's expected number of correct answers?

6 marks

Answer all questions with full solutions. Make sure your work is legible, even after you have scanned it, and submit it as a single file.

1. Look at the sketches of continuous probability distributions below.



   For each sketch, give an example of a situation which might give rise to such a probability distribution, fully explaining your reasoning.

   (6 marks)

2. In many situations, the normal distribution can be used to approximate the binomial distribution.
   a. Explain the conditions in which this can be done, and explain why we might want to take advantage of this property.
   b. Give an example of a situation in which we could do this.
   c. Give an example of a situation in which we would not be able to make this approximation and explain why.

   (6 Marks)

3. A species of alien has a mean height of 23 cm and a standard deviation of 3.6 cm. What is the probability that an alien chosen at random has a height of more than 20cm?

   (6 Marks)

4. Researchers have observed that regular smokers have an average lifespan that is normally distributed and is 68 years with a standard deviation of 10 years. What percent of smokers will live beyond age 76?

   (4 Marks)

5. The life span of a particular species of turtle are normally distributed with a mean of 180 years and a standard deviation of 40 years. What is the probability that one of these turtles will live more than a century?

   (4 Marks)

6. A second species of alien has a mean height of 71 cm and a standard deviation of 5.3 cm. An alientologist discovers that 30% of them bump their heads getting into their spaceship. What is the height of the spaceship door?

   (6 Marks)

7. In Bayfield, 65% of residents read the Bayfield Breeze, a local online blog. Dennis wants to know what people think of the blog, so he stops 40 people on the street to ask them if they read it.
   a. Verify that the normal distribution can be used to approximate this situation.
   b. What is the mean and standard deviation of the number of people he finds that read the Breeze?
   c. What is the probability that at least 25 of the people he asks read the blog?

   (9 Marks)

8. Yuen Zhi is running a ring toss event at a school fair.
   There is a 15% chance that each attempt wins a prize. She has 45 prizes and believes 250 people attempt the event.
   She is worried she won't have enough prizes. Can you reassure her she will probably be ok?

   (9 Marks)

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9. We have been using the normal distribution to approximate situations that are in fact binomial events.
    a. Demonstrate how accurate the approximation is by using both approaches to find the probability of the same event.
    b. Describe the conditions under which the normal would give a less accurate approximation.
    c. Explain a situation in which the criteria for using the approximation would be met, ie. $np \geq 5$ and $n(1 - p) \geq 5$, and yet you would decide not to use the normal distribution.

    (10 Marks)