Name: Dhrumil Patel

Unit #1 Test - Probability: Discrete Random Variables

K/U: ______	Application: ______	Communication: ______	TOTAL: ______
13	22	7	42

Knowledge/Understanding: (13 marks)

Multiple Choice: Circle the most appropriate answer from the following choices. *<9 marks>*

1. Which of the following symbolizes the number of elements in subset A?

   a) $n(A)$ b) $P(A)$ c) $\# A$ d) $n(A^c)$

2. The key word "AND" is associated with which of the following sets?

   a) A^c b) $(A \cap B)$ c) $(A \cup B)$ d) $(A \mid B)$

3. The collection of all possible outcomes in an experiment is called the:

   a) Event space b) Subset Space c) Possibility Space d) Sample Space

4. Which symbol is used to represent the union of two sets?

   a) $\cup$ b) $\cap$ c) $\not\subset$ d) &

5. If A and B are mutually exclusive events, then:

   a) $P(A \cap B) = P(A) + P(B)$ b) $P(A) + P(B) = 1$ c) $P(A \cup B) = P(A) + P(B)$ d) $P(A \cup B) = 1$

6. There are 18 red number cards (2 – 10) in a standard 52 card deck. The odds against selecting a red number card is: **fractions have been reduced to lowest terms

   a) $9:17$ b) $17:9$ c) 9:26 d) 26:9

7. Identify which situation represents dependent events:

   a) Drawing two cards from a deck without replacement b) Rolling a pair of dice one after the other c) Flipping a coin twice a) None of the above

8. Two sets A and B are said to be **disjoint** if:

   a) $(A \cap B) = \varnothing$
   b) $n(A \cup B) = 0$
   c) $n(A \cap B) = n(A) + n(B)$
   d) $n(A \cap B) = n(A) = n(B)$

9. Which of the following is the additive principle for counting?

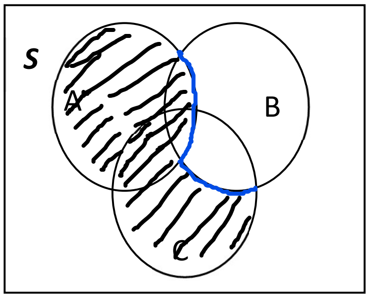
   a) $n(A \cap B) = n(A) + n(B) - n(A \cup B)$
   b) $n(A) + n(B) = n(A \cap B)$
   c) $n(A) + n(B) = n(A \cup B)$
   d) $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

Short Answer <4 marks>

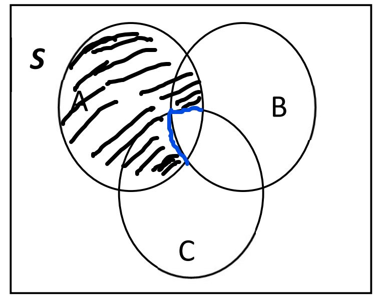
Name:____________________________________

10. Shade the appropriate sections of each of the following diagrams: *<2 marks>*

a) $(B^C \cap C) \cup A$



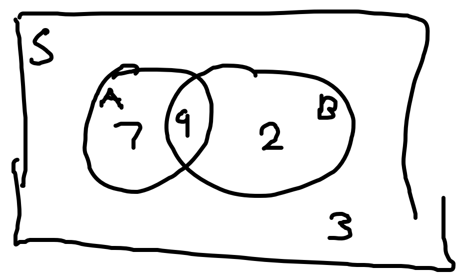
b) $(B \cap C)^C \cap A$



11. A store has 21 different cell phones. 16 come with car chargers, 11 have Bluetooth headsets, and 9 of the phones have both a charger and a headset. How many phones come with neither a charger nor a headset?

Either a Venn Diagram OR an equation can be used *<2 marks>*

Let A be the number of phones w/ car chargers
Let B be the number of phones w/ BT headsets



$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$= 16 + 11 - 9$

$= 18$

$n(S) - n(A \cup B)$

$= 21 - 18$

$= 3$ $\therefore$ 3 phones come with neither a charger nor a headset.

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Application: (22 marks)

1. Determine the probability of rolling doubles or a sum of 9 when rolling two dice. *<2 marks>*

(You can list the possible outcomes; no need to make an entire table if you choose to take that route)

Doubles: (1,1), (2,2), (3,3), (4,4), (5,5), (6,6)
(1^{st}, 2^{nd} dice)
$n(\text{Doubles}) = 6$

$P(\text{Doubles}) = \frac{n(\text{Doubles})}{n(S)} = \frac{6}{36} = \frac{1}{6}$

$n(S) = n(1^{st}\text{ die}) \times n(2^{nd}\text{ die}) = 6\times 6 = 36$

Sum of 9: (3,6), (4,5), (5,4), (6,3)
$n(\text{Sum of } 9) = 4$

$P(\text{Sum of } 9) = \frac{n(\text{Sum of } 9)}{n(S)} = \frac{4}{36} = \frac{1}{9}$

$P(\text{Doubles} \cup \text{Sum of } 9)$
$= P(\text{Doubles}) + P(\text{Sum of } 9)$
$= \frac{1}{6} + \frac{1}{9} = \frac{5}{18} = 27.8\%$

$\therefore$ There is a $\frac{5}{18}$ or 27.8% chance of rolling doubles or a sum of 9 when rolling 2 dice.

2. Using a standard deck of 52 playing cards, what is the probability of each of the following: *<4 marks>*

a) Drawing a face card, not replacing it, then draw an ace?

$P(\text{Face}) \times P(\text{Ace} \mid \text{Face})$
$= \left(\frac{12}{52}\right)\left(\frac{4}{51}\right)$
$= \frac{48}{2652}$
$= \frac{4}{221}$
$= 0.0181$

$\therefore$ There is a $\frac{4}{221}$ or 1.8% chance of drawing a face card, then an ace w/out replacement.

b) drawing a black card or drawing a number card.

↳ spades, clubs ↳ cards 2-10

$P(\text{black} \cup \text{number}) = P(\text{black}) + P(\text{number}) - P(\text{black} \cap \text{number})$
$= \frac{26}{52} + \frac{36}{52} - \frac{18}{52}$
$= \frac{44}{52}$
$= \frac{11}{13}$
$= 85\%$

$\therefore$ There is a $\frac{11}{13}$ or 85% chance of drawing a black card or a number card.

3. Four coins are tossed at the same time, find the probability that: *<4 marks>*

a) All four come up tails

$P(T \cap T \cap T \cap T) = P(T) \times P(T) \times P(T) \times P(T)$
$= \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$
$= \frac{1}{16}$
$= 6.25\%$

$\therefore$ There is a $\frac{1}{16}$ or 6.25% chance of all 4 coins coming up tails.

b) At least one comes up heads

$P(\text{At least one heads}) = 1 - P(\text{no heads})$
$= 1 - P(\text{all tails})$
$= 1 - \frac{1}{16}$ (From part a)
$= \frac{15}{16}$
$= 93.75\%$

$\therefore$ There is a $\frac{15}{16}$ or 93.75% chance of at least coming up heads

4. A survey is done, and the results are tallied in the table. *<2 marks>*
   i) Complete the table.
   ii) If a person is selected at random, determine the probability that they enjoy "Monster Legends" given that they are a teenager.

	Child	Teenager	Adult	Total
Enjoy Monster Legends	42	39	7	88
Do not enjoy Monster Legends	27	33	51	111
Total	69	72	58	199

Let "enjoys Monster Legends" be the event ML

$P(ML \mid \text{Teen})$

$= \frac{P(ML \cap \text{Teen})}{P(\text{Teen})}$

$= \frac{\frac{39}{199}}{\frac{72}{199}}$

$= \frac{39}{199} \times \frac{199}{72}$
$= \frac{39}{72}$
$= \frac{13}{24}$
$= 54.17\%$

$\therefore$ There is a $\frac{13}{24}$ or 54.17% chance that the randomly selected person likes monster legends given that they are a teenager.

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5. Given: S = {letters in the word FLOURISHED} A = {FLOUR}, B = {vowels of S}, and C = {consonants of S}
List the elements, or number of elements, in each set: <6 marks>

B={O,U,I,E}, C={F,L,R,S,H,D}

a) A^c {I,S,H,E,D}

d) n(S^c) 0

b) $B \cap C$ {ϕ}

e) n($(A \cap B) \cup C$) 8

c) $(A \cup B)^c$ {S,H,D}

f) n($A \cap C^c$) 2

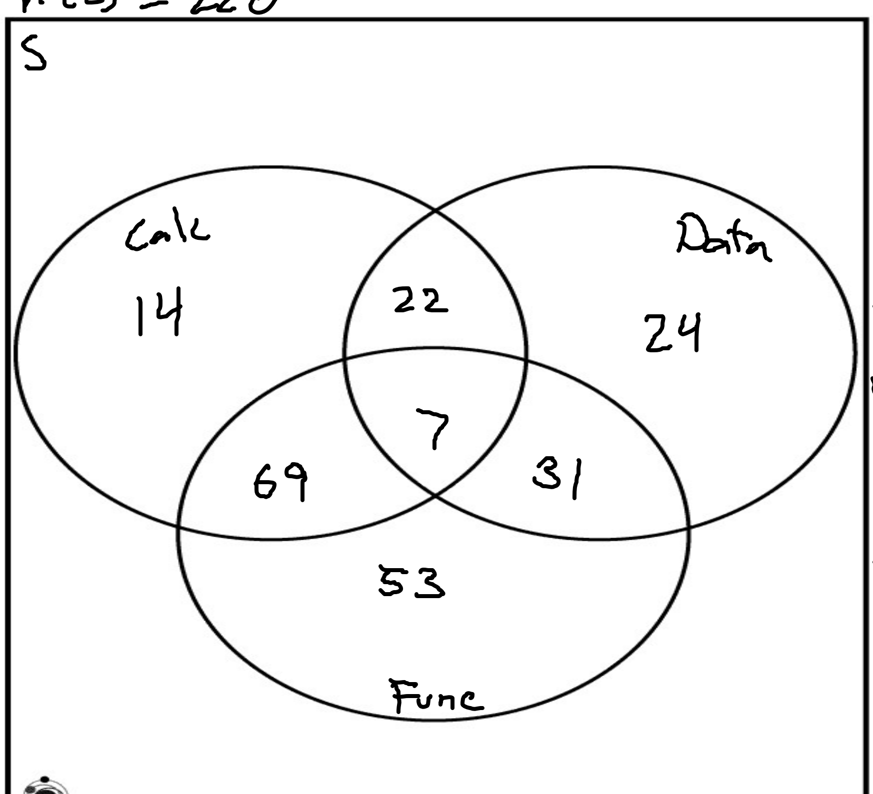
6. 220 students have enrolled in at least one Grade 12 university level math course: <4 marks>

- 112 are in Calculus
- 84 are in Data Management
- 76 are in Calculus and Advanced Functions
- 38 are in Advanced Functions and Data Management
- 29 are in Calculus and Data Management
- 7 are in all three

a) Draw a Venn Diagram to illustrate the situation

b) How many students take Advanced Functions? 160

n(S) = 220



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n(Just Calc) = n(Calc) − n(all)
− n(Data ∩ Calc)
− n(Func ∩ Calc)
= 112 − 7 − 22 − 69
= 14

n(Just Data) = n(Data) − n(all)
− n(Data ∩ Calc)
− n(Data ∩ Func)
= 84 − 7 − 22 − 31
= 24

n(Just Func) = n(S) − n(Data ∪ Calc)
= 220 − 112 − 24 − 31
= 53

n(Func) = n(Just Func) + n(all) + n(Calc ∩ Func)
+ n(Data ∩ Func)
= 53 + 69 + 7 + 31 = 160 ∴ 160 students take adv. func.

Name:______________________________________

Communication: (7 marks)

Communication:	Level 1	Level 2	Level 3	Level 4	Mark
Use of conventions, vocabulary, and terminology of the discipline in visual and written forms	Uses conventions, vocabulary, and terminology of the discipline with limited effectiveness.	Uses conventions, vocabulary, and terminology of the discipline with some effectiveness.	Uses conventions, vocabulary, and terminology of the discipline with considerable effectiveness.	Uses conventions, vocabulary, and terminology of the discipline with a high degree of effectiveness.	____ / *2*

Completed the evaluation in the allotted time: /1C

Please use POINT FORM for your answers to the following questions:

1. Studies show that when people are asked to pick a random number from 1 to 6, more than half of the people will choose the same number. Explain why the probability of a person choosing a certain number would not be the same as the probability of rolling that same number on a single die.

<2 marks>

- Probability of rolling any number on a single die is equal to that of rolling any other number on the die. There is no bias for a single number. This is why the probability of rolling a specific number on a die is $\frac{1}{6}$.
- If $> \frac{1}{2}$ of people choose the same number, there is a clear bias for that number. The probability that people will choose that number is clearly not $\frac{1}{6}$. The probability that they will choose other numbers is different because of this bias. Thus, the probability of a person choosing a certain number is diff. from the probability of rolling that number.

2. If events A and B are mutually exclusive, explain why $P(A \cup B)$ is simply the sum of the probabilities of each event. Include an example.

<2 marks>

Suppose A is rolling a 3 on a single die

Suppose B is rolling a 4 on that die.

A and B are mutually exclusive events since both events cannot happen together and if one happens, it is guaranteed that the other does not.

if A happens, you rolled a 3. There is no way that B happens (rolling a 6)

Thus, $P(A \cap B) = 0$. From the additive principle of counting: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\therefore P(A \cup B) = P(A) + P(B)$. Thus, the probability of A or B is simply the sum of the probability of A and the probability of B.