# Section 5: Probability, Statistics, and Graphs

**This book belongs to:**_____ **Block:** _____

| Section | Due Date | Questions I Find Difficult | Marked | Corrections Made and Understood |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

## Self-Assessment Rubric

| Category | Sub-Category | Description | |
|---|---|---|---|
| Expert | 6 | Work meets the objectives; is clear, error free, and demonstrates a mastery of the Learning Targets | "You could teach this!" |
| | 5 | Work meets the objectives; is clear, with some minor errors, and demonstrates a clear understanding of the Learning Targets | "Almost Perfect, one little error." |
| Apprentice | 4 | Work almost meets the objectives; contains errors, and demonstrates sound reasoning and thought concerning the Learning Targets | "Good understanding with a few errors." |
| | 3 | Work is in progress; contains errors, and demonstrates a partial understanding of the Learning Targets | "You are on the right track, but key concepts are missing." |
| Novice | 2 | Work does not meet the objectives; frequent errors, and minimal understanding of the Learning Targets is demonstrated | "You have achieved the bare minimum to meet the learning outcome." |
| | 1 | Work does not meet the objectives; there is no or minimal effort, and no understanding of the Learning Targets | "Learning Outcomes not met at this time." |

## Learning Targets and Self-Evaluation

| Learning Target | Description | Mark |
|---|---|---|
| $5-1$ | • Discussion of outliers, sample vs population<br>• Calculating central tendency: Mean/Median/Mode | |
| $5-2$ | • Difference between theoretical and experimental probability<br>• Calculating Experimental probability from data and in games | |
| $5-3$ | • Displays information is pictographs, infographics etc.<br>• Continuous versus discrete data's influence on: line/bar/circle graph | |

## Competency Self-Evaluation

A valuable aspect to the learning process involves self-reflection and efficacy. Research has shown that authentic self-reflection helps improve performance and effort, and can have a direct impact on the growth mindset of the individual. In order to grow and be a life-long learner we need to develop the capacity to monitor, evaluate, and know what and where we need to focus on improvement. Read the following list of Core Competency Outcomes and reflect on your behaviour, attitude, effort, and actions throughout this unit.

Rank yourself with a check mark: E (Excellent), G (Good), S (Satisfactory), N (Needs Improvement)

| | | E | G | S | N |
|---|---|---|---|---|---|
| **Personal Responsibility** | • I **listen** during instruction period and come to class ready to ask questions | | | | |
| | • I am **fully prepared** for Unit Quizzes | | | | |
| | • I am **fully prepared** to re-Quizzes | | | | |
| | • I **follow** instructions and **assist** peers<br>• I am **on task** during work blocks<br>• I **complete** assignments **on time** | | | | |
| | | | | | |
| **Self-Regulation** | • I keep track of my **Learning Targets** | | | | |
| | • I take **ownership** over my goals, learning, and behaviour<br>• I can **solve problems** myself and know when to ask for help<br>• I can **persevere** in challenging tasks<br>• I **take responsibility** to be actively engaged in the lesson and discussions | | | | |
| | • I only use my phone for school tasks | | | | |
| | | | | | |
| **Classroom Responsibility and Communication** | • I am **focused** on the discussion and lessons<br>• I **ask questions** during the lesson and class<br>• I give **my best effort** and **encourage** others to work well<br>• I am polite and communicate questions and concerns with my peers and teacher | | | | |
| | | | | | |
| **Collaborative Actions** | • I can **work with others** to achieve a common goal<br>• I make **contributions** to my group<br>• I **am kind** to others, can work collaboratively and **build relationships** with my peers<br>• I **can identify** when others need support and provide it | | | | |
| | | | | | |
| **Communication Skills** | • I present informative **clearly**, in an organized way<br>• I **ask and respond** to simple direct questions<br>• I am an **active listener**, I support and encourage the speaker<br>• I **recognize** that there are different points of view and can disagree respectfully | | | | |
| | **Overall** | | | | |

**Goal for next Unit** – refer to the above criteria. **Please select** (underline/highlight) **two areas** you want to focus on

# Section 5.1 – Statistics and Central Tendency

## Sample vs Population

- A **population** is the **totality** of all things under consideration
  - Example: All the students in school district 61
- A sample is a **selection of participants** from the population
  - Example: Only students at Mount Doug
- In order for a study to be free of bias, or skewed results, you need a true **RANDOM SAMPLE**.

**Example:**

If I were looking to do a survey of people in Victoria who think we need to improve the BC transit system, I need to make sure my **sample is random**.

- If I asked people at bus stops, will that have a bias on my results?

Absolutely! Since you are asking people at the bus stop, you can assume they ride the bus regularly and therefore have a skewed response regarding BC transit.

How do you get a **Random Sample**?

There are many methods:

- Open the phonebook to a random page
- Put all the people's names in a hat and draw them out
- Use a random selection computer generation program

- Statistics is the **mathematical approach** of **gathering data**
  - **Data** is the **information** gathered in a study, the answers to the questions you pose

- Data is gathered by posing a question to a Sample of individuals, the question can be open-ended, but usually has a **set of choice responses**
- Remember to choose your sample **randomly to limit bias** in the responses

**Example of Sample versus Population**

**Sample:** 500 people chosen at random from the Victoria phonebook

**Population:** The city of Victoria

Gathering the data is where you start, the more data you have the more reflective of a population the results may be.

- Think about if you asked: Do you prefer Pepsi of Coke and randomly selected 2 people
- Your stats would look like this:

| *Pepsi* | *Coke* |
|---|---|
| 100% | 0% |
| 50% | 50% |
| 0% | 100% |

Not really the best reflection of a population

The more data you have, the accurate your predictions will be.

So gather as much information as you can in order to achieve results that will be Statistically Significant

**Central Tendency**

- Is the Central of Typical value with respect to the distribution of the statistics
- We will look at and discuss these three:
    - The MEAN – The average of the values you have collected
    - The MEDIAN – The middle term of the list of data, written smallest to largest
    - The MODE – The term that occurs the most in a given set of data

The Median is often used in describing data compared to the Mean in statistics because it is not skewed by outliers that are excessively high and/or low, and may give a better idea of the typical value.

**Example:** Calculate the Mean, Median, and Mode of the following data set.

$$12, 13, 20, 10, 15, 17, 21, 37, 22, 13, 10, 17, 21, 21, 37$$

**Solution:** Rewrite the info in ascending order first to find the MEDIAN AND MODE

$$10, 10, 12, 13, 13, 15, 17, 17, 20, 21, 21, 21, 22, 37, 37$$

So now we can see that the **MODE** is: 21 (it appears three times)

So now we can see that the **MEDIAN** is: 17 (7 items on either side of it)

So now we can calculate the **MEAN** is: 19.07 (Add all the terms up and divide by the total number)

## Section 5.1 – Practice Problems

What are 3 examples of Sample vs Population.

1. Grade 9's vs All grades
2. BC vs Canada
3. Dog owners vs Pet Owners

} Answers will vary

Using the following sets of Data, calculate the Mean, Median, and Mode

4. Ages of a Sample Group

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 12 | 14 | 19 | 12 | 14 | 15 | 15 | 16 | 15 | 18 |

12, 12, 14, 14, 15, 15, 15, 16, 18, 19
5 5

Mean: 15
Median: 15
Mode: 15

- Median is the middle
- Average 15 and 15

5. Average Temperature over a 30 Day Period

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 24° | 21° | 18° | 19° | 12° | 21° | 27° | 29° | 19° | 18° |
| 24° | 23° | 17° | 19° | 26° | 15° | 19° | 20° | 20° | 13° |
| 19° | 23° | 27° | 20° | 21° | 23° | 23° | 19° | 27° | 23° |

Mean: $\frac{629}{30} = 20.96 \doteq 21°$

Mode: 19°

Median: 20.5°

## Section 5.2 – Theoretical and Experimental Probability

- Both Theoretical and Experimental Probability are calculated the same way

$$\frac{The\ number\ of\ times\ something\ happened}{The\ number\ of\ times\ we\ tried}$$

So to understand the difference between the two, let's look at the tossing of a coin.

**Theoretical Probability:** What we expect to happen

**Experimental Probability:** What actually happened

**Example:** What are the odds of flipping heads?

**Solution:**

**Theoretical Probability** tells us that it is: $50\%$ (one or the other, over an infinite number of flips)

**Experimental Probability** requires some trials:

| | |
|---|---|
| *Heads* | 13 |
| *Tails* | 7 |
| *Total* | 20 |

**Heads:** $\frac{13}{20} = \frac{65}{100} = 65\%$

**Tails:** $\frac{7}{20} = \frac{35}{100} = 35\%$

The more we flip we will see that the outcomes will eventually even out, it may take an extremely large number of attempts!

Now let's look at dice.

Theoretically: If you throw 1 die, then there is a $1\ in\ 6$ chance of getting any of the numbers: $16.6\%$

Experimentally: We need some trials

| *Number* | *Outcome* |
|---|---|
| 1 | 4 |
| 2 | 5 |
| 3 | 8 |
| 4 | 1 |
| 5 | 3 |
| 6 | 4 |

Odds of rolling a 5: $\frac{3}{25} = \frac{12}{100} = 12\%$

Odds of rolling an even number: $\frac{10}{25} = \frac{40}{100} = 40\%$

Odds of rolling a 3 *or* 1: $\frac{12}{25} = \frac{48}{100} = 48\%$

Experimental Probability differs from the theoretical and can have more interesting predictive capabilities over small sequences of attempts

## Section 5.2 – Practice Problems

Using two dice. First fill in the grid with all the possible outcomes of a roll with two dice.

| Die #2 \ Die #1 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 1,1 | 1,2 | 1,3 | 1,4 | 1,5 | 1,6 |
| 2 | 2,1 | 2,2 | 2,3 | 2,4 | 2,5 | 2,6 |
| 3 | 3,1 | 3,2 | 3,3 | 3,4 | 3,5 | 3,6 |
| 4 | 4,1 | 4,2 | 4,3 | 4,4 | 4,5 | 4,6 |
| 5 | 5,1 | 5,2 | 5,3 | 5,4 | 5,5 | 5,6 |
| 6 | 6,1 | 6,2 | 6,3 | 6,4 | 6,5 | 6,6 |

What is the Theoretical Probability of the following:

1. Rolling any doubles: $\frac{6}{36} = \frac{1}{6}$
2. Rolling 6: $\frac{5}{36}$
3. Rolling 4: $\frac{3}{36} = \frac{1}{12}$
4. Rolling Double 5's: $\frac{1}{36}$
5. Rolling 7: $\frac{6}{36} = \frac{1}{6}$
6. Rolling 3: $\frac{2}{36} = \frac{1}{18}$

| *Number Rolled* | *Frequency* |
|---|---|
| 2 | 4 |
| 3 | 7 |
| 4 | 5 |
| 5 | 3 |
| 6 | 9 |
| 7 | 12 |
| 8 | 10 |
| 9 | 8 |
| 10 | 2 |
| 11 | 7 |
| 12 | 4 |

Total: 71

Using the table what is the experimental probability of the following:

7. Probability of rolling a 5: $\frac{3}{71}$
8. Probability of rolling an 8: $\frac{10}{71}$
9. Probability of rolling a 4: $\frac{5}{71}$
10. Probability of rolling an even number: $\frac{34}{71}$
11. Probability of rolling an odd number: $\frac{37}{71}$
12. Probability of rolling a Prime Number: $\frac{33}{71}$

## Section 5.3 – Graphing

- Graphing provides us with a way of visualizing **DATA**
- We will discuss a few here and put more focus on Bar/Line/Circle Graphs

The first three we will look at are:

**Pictographs:** A way of showing data using images

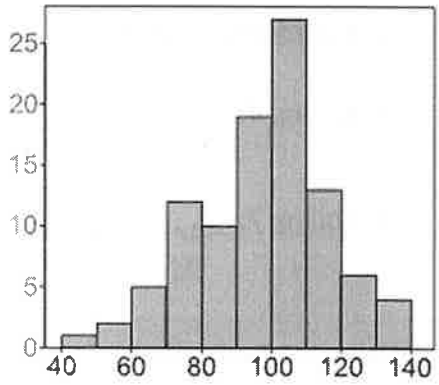
Pictographs have been used since the beginning of human civilization. Examples have been found as early as $3000BC$ in Egypt and Mesopotamia.

Favorite cookie

| Cookie | Number of students |
|---|---|
| Peanut butter | ●●●●● |
| Chocolate chip | ●●●● |
| Ginger snap | ●● |
| Animal cracker | ●●● |
| Each ● = 2 cookies | |

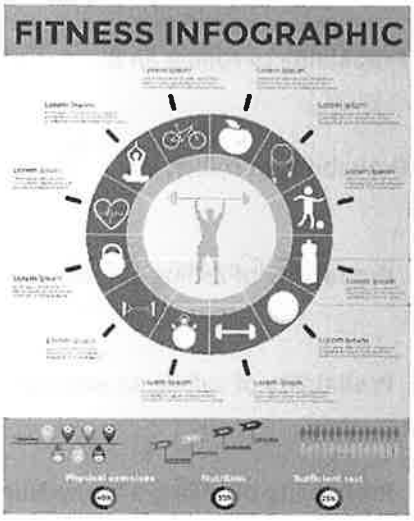
**Histograms:** Similar to a Bar Graph, made up of bars of info that represent continuous data, broken into bars that represent groups of ranges

Histograms, as a bar graph, is a way of showing information that represents continuous data without having to use a line graph.




**Infographic:** Graphic representation of information, data, knowledge etc. They play a critical role in marketing and advertising.

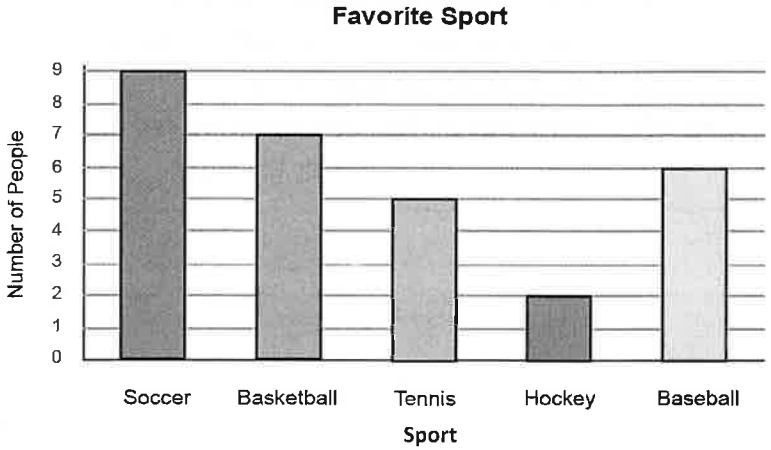
Infographics focus heavily on images to catch attention and portray information clearly, they still involve written information, but the images help to get the message out



The next three graphs we will look at in more detail.

**Bar Graph:** A graph of data, discrete in its topics, that represents the data using bars

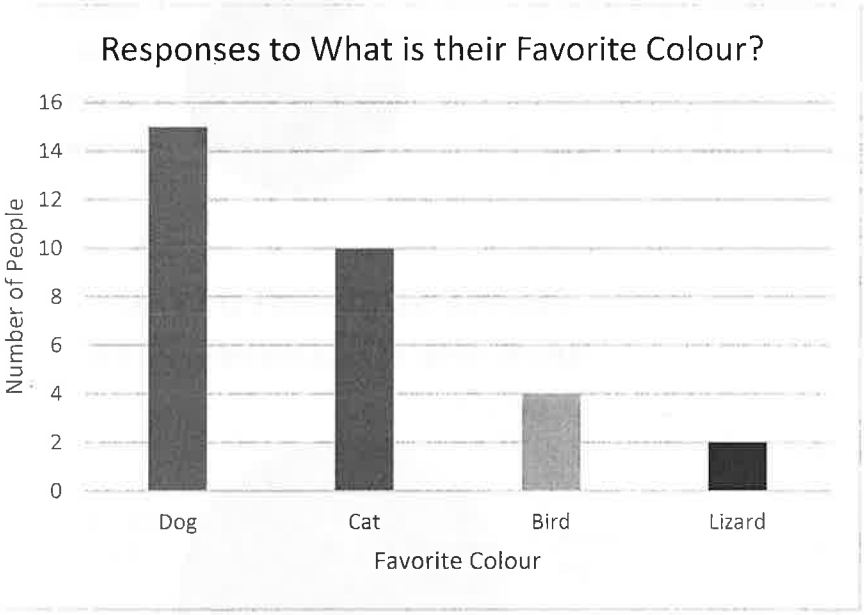
- You can see the Bar's represent discrete data (different concrete possibilities)
- The graph has a title and the axis are labeled




**Example:** Graph the following data as a bar graph

**Solution:**

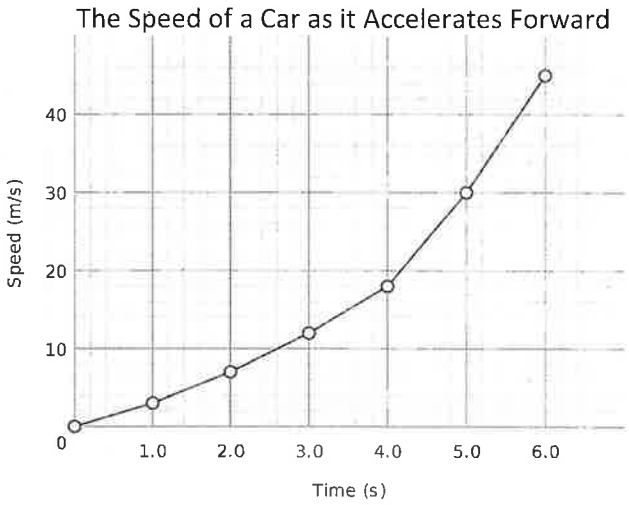
| # of people | Favorite Colour |
|---|---|
| 7 | Red |
| 5 | Blue |
| 12 | Purple |
| 9 | Green |




- This unit we will be making Bar Graphs by hand and using the Computer

**Line Graph:** A graph that shows data, represented continuously, which means there isn't a break in the data

- You can see the $x-axis$ represents time, which can be pin-pointed to any point. That is what we mean by continuous data.
- If the line graph is in fact continuous we can interpolate and extrapolate for the graph




**Circle Graphs:** The hardest to produce by hand. The data needs to be analyzed and broken down into a percentage, then the percentage needs to be multiplied by 360 so that we have partitions of the 360° circle. We start with an arbitrary radius and measure the corresponding angles from there.

**Example:** Given the following information, make a circle graph to display it.

| *# of People* | 15 | 10 | 4 | 2 | 7 |
|---|---|---|---|---|---|
| *Pets* | *Dog* | *Cat* | *Bird* | *Lizard* | *Other* |


**Solution:**

Total Number of People Surveyed: 38

Need a percentage of 360°

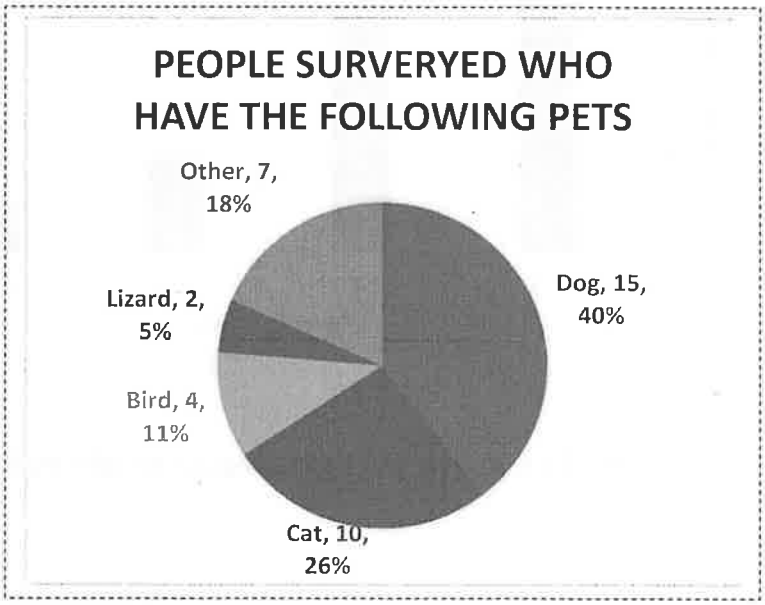
Dog: $\frac{15}{38} = 0.395 = 40\% \rightarrow 0.395 * 360 = 142°$

Cat: $\frac{10}{38} = 0.263 = 26\% \rightarrow 0.263 * 360 = 95°$

Bird: $\frac{4}{38} = 0.105 = 11\% \rightarrow 0.105 * 360 = 38°$

Lizard: $\frac{2}{38} = 0.053 = 5\% \rightarrow 0.053 * 360 = 19°$

Other: $\frac{7}{38} = 0.184 = 18\% \rightarrow 0.184 * 360 = 66°$



## Section 5.3 – Practice Problems

The following can and should be made of separate pieces of paper.

1. Create a Pictograph of your choice
2. Create an Infographic of your choice

ANSWERS WILL VARY

3. Using the following date create both a Bar Graph and Circle Graph by hand

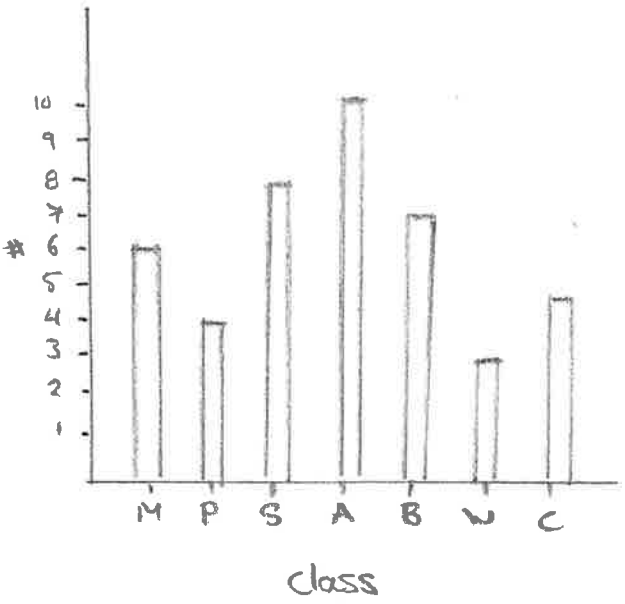
Students were asked what their favorite course was in school. The answers were as follows.

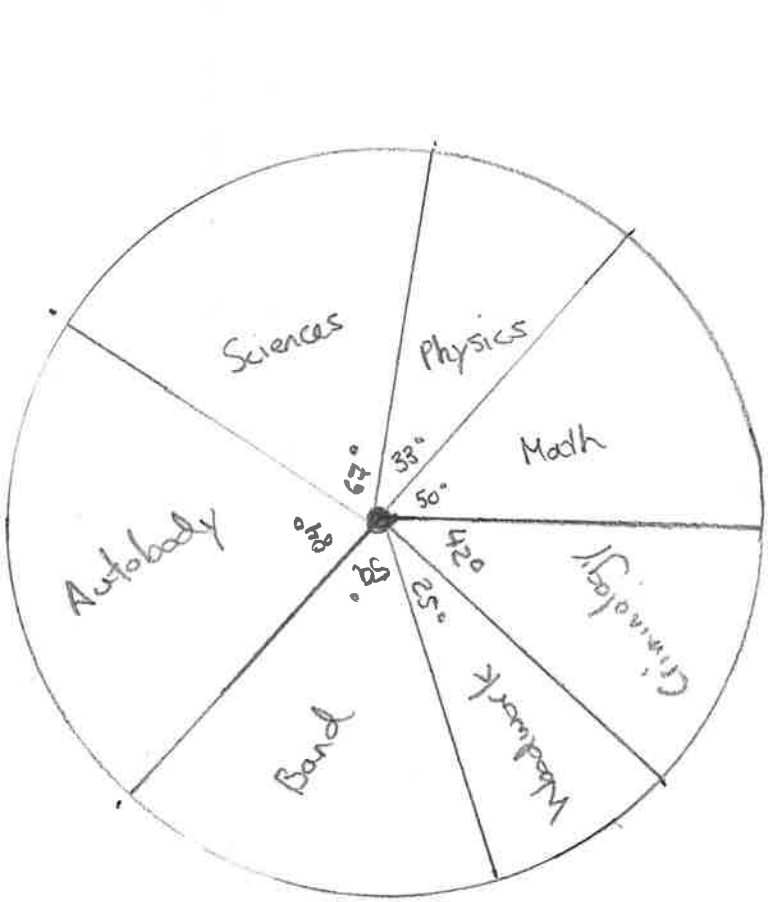
| *Math* | *Physics* | *Science* | *AutoBody* | *Band* | *Woodwork* | *Criminology* |
|---|---|---|---|---|---|---|
| 6 | 4 | 8 | 10 | 7 | 3 | 5 |

Total : 43

Multiply by 360° to get →

| 6/43 | 4/43 | 8/43 | 10/43 | 7/43 | 3/43 | 5/43 |
|---|---|---|---|---|---|---|
| 50° | 33° | 67° | 84° | 59° | 25° | 42° |



Answer Key

**Section 5.1**

1. *Answer will Vary*
2. *Answer will Vary*
3. *Answer will Vary*
4. *Mean*: 15
   *Median*: 15
   *Mode*: 15
5. *Mean*: 21°
   *Median*: 20.5°
   *Mode*: 19°

**Section 5.2**

1. $\frac{1}{6}$
2. $\frac{5}{36}$
3. $\frac{1}{12}$
4. $\frac{1}{36}$
5. $\frac{1}{6}$
6. $\frac{1}{18}$
7. $\frac{3}{71}$
8. $\frac{10}{71}$
9. $\frac{5}{71}$
10. $\frac{34}{71}$
11. $\frac{37}{71}$
12. $\frac{33}{71}$

**Section 5.3**

See Website Copy