**Math Reviewer**

**Logical Reasoning**

**Inductive Reasoning:**

* **Inductive Reasoning (Specific to General)** – A process of observing data, recognizing patterns, and making generalizations from observations. Unlike deductive reason, inductive reasoning makes use of specific statements to create general statements which is used to creating generalizations.
* **Conjecture** – A generalization of inductive reason, specifically an educated guess based on incomplete information, often used in math.
* **Theorem** – If a conjecture is proven in becomes a theorem.
* **Syllogism** - by utilizing deductive reasoning, you can draw conclusions based on a **major premise** (general statement), and **minor premise** (particular statement) which are accepted as true.
* **Deductive Reasoning (General to Specific)** – A kind of reasoning that starts from a general statement to a particular statement. From a general statement that has been accepted as true, you can create a specific statement which is mostly used proving statements.
* Specifically, by utilizing deductive reasoning, you can draw conclusions based on a **major premise** (general statement), and **minor premise** (particular statement) which are accepted as true. These comprise a **syllogism.**
* **Hypothesis** – A testable explanation for an explanation for an observation on a scientific question commonly used in science. It is tested through experiments and observations. If given enough data, it becomes a theory (A GAME THEORY!!!??!!?!?!).

|  |  |
| --- | --- |
| **Example 1:** | **Legend:** |
| **Example 2:** | |
| **Example 3:** | |
| **Example 4:** | |

**Conditional Statements**

* **Hypothesis** – A testable statement or prediction about the relationship between variables.
* **Conclusion** – The final interpretation of results based on evidence from an experiment or study.
* A conditional statement has two parts: a hypothesis, and a conclusion. To write a conditional statement in symbols, we let be the hypothesis and be the conclusion. Now, the statement, *“If , then ”* can be written as:

**Transforming a Statement into an Equivalent If-then Statement:**

* Determine the appropriate hypothesis and conclusion for the statement.
* Express the hypotheses and the conclusion into the if-then form of a statement.
* Use appropriate pronouns or terms in constructing the conclusion part of the statement.

**Converse, Inverse, and Contrapositive:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Conditional Statement** | If p, then q | P > Q | If |
| **Converse** | If q, then p | Q > P | If we can eat the snow, then it is thick enough. |
| **Inverse** | If ~p, then ~q | ~P > ~Q | If the snow is not thick enough, then we cannot eat it. |
| **Contrapositive** | If ~q, then ~p | ~Q > ~P | If we cannot eat the snow, then it is not thick enough. |

**Deductive and Inductive Reasoning:**

* **Deductive Reasoning (General to Specific)** – A kind of reasoning that starts from a general statement to a particular statement. From a general statement that has been accepted as true, you can create a specific statement which is mostly used proving statements.

1. Specifically, by utilizing deductive reasoning, you can draw conclusions based on a **major premise** (general statement), and **minor premise** (particular statement) which are accepted as true. These comprise a **syllogism.**

* **Inductive Reasoning (Specific to General)** – A process of observing data, recognizing patterns, and making generalizations from observations. Unlike deductive reason, inductive reasoning makes use of specific statements to create general statements which is used to creating generalizations.

**Citation needed from previous quiz**

**Parallel Lines**

**Geometry Terms and Symbols:**

* **Geometry** – Comes from the two Greek word, “Geo,” which means earth. And “metron” which means, a plane

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Meaning** | **Example** | **In Words** |
|  | Triangle |  | Triangle ABC has three equal sides |
|  | Angle |  | The angle formed by ABC is 45 degrees. |
|  | Perpendicular |  | The line AB is perpendicular to line CD |
|  | Parallel |  | The line EF is parallel to line GH |
|  | Degrees |  | 360 degrees (a full rotation!) |
|  | Right Angle (90°) |  | A right angle is 90 degrees |
|  | Line Segment "AB" |  | The line segment between A and B |
|  | Line "AB" |  | The infinite line that includes A and B |
|  | Ray "AB" |  | The line that starts at A, goes through B and continues on |
|  | Congruent (same shape and size) |  | Triangle ABC is congruent to triangle DEF |
|  | Similar (same shape, different size) |  | Triangle DEF is similar to triangle MNO |
|  | Therefore |  | a equals b, therefore b equals a |

**Angles Formed by a Transversal:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Transversal:** | **Angles:** |  | **Types of Lines:**   * **Line Segment** – A line with 2 end points * **Ray** – Starts from one point and ends with a direction. * **Intersecting Lines** – Passes through the same point. * **Perpendicular** – Intersect at right angles. * **Skew Line** – Lines that are noncoplanar and do not intersect * **Parallel Lines** – Lines that are coplanar and do not intersect. * **Oblique Lines** – Lines that intersect at any angle other than right angle. * **Transversal Lines** – A line that intersects two or more coplanar lines at different points. |
| **External Angles** | ∠1 and ∠2 |
| ∠7 and ∠8 |
| **Internal Angle (Supplementary)** | ∠3 and ∠4 |
| ∠5 and ∠6 |
| **Corresponding Angles (Congruent)** | ∠1 and ∠5 |
| ∠3 and ∠7 |
| ∠2 and ∠6 |
| ∠4 and ∠8 |
| **Vertical Angles** | ∠1 and ∠4 |
| ∠2 and ∠3 |
| ∠5 and ∠8 |
| ∠6 and ∠7 |
| **Alternate External Angle (Congruent)** | ∠1 and ∠8 |
| ∠2 and ∠7 |
| **Alternate Internal Angles (Congruent)** | ∠3 and ∠6 |
| ∠4 and ∠5 |

**Functions and Relations**

**Terminologies:**

* **Domain** – The **complete set of all possible input values** (typically represented by **x**) that can be used in the function **without causing any mathematical errors** (first elements of the ordered pairs).
* **Relation** – **Relation** is simply a **connection** or a **pairing** between two things — usually **inputs** and **outputs**. It is the pair itself.
* **Range** – The **complete set of all possible output values** (usually represented by **f(x)** or **y**) that result from using every value in the domain. (second elements of the ordered pairs).
* **Function** – A special type of rule or process in mathematics **that connects one thing to another.** More specifically, it connects an **input** to exactly **one output**.
* A function is a **special type of relation** where every **input** (the first element of the ordered pair) has exactly one **output** (the second element of the ordered pair).
* You can think of a function as a **machine**: you put something in (input), and the machine gives you something out (output). But the machine can’t give you more than one output for a single input.
* Each **input** is related to **exactly** **one** **output**; **no input** can be **paired** with **more** **than** **one** **output**.

**Dependent and Independent Value:**

* **Independent Variable** – The **input** value in a function.
* **Dependent Variable** – The **output** value in a function.

|  |
| --- |
| **Example:**   * This is a relation where: Jamine is 25 years old; Inigo is 30 years old, and Mavuika is 22 years old. * So, this relation is just a collection of pairs, and each pair describes the relationship between a person (the first element) and their age (the second element). |

|  |  |
| --- | --- |
| **Example: Function**   * This is a function because every person only corresponds to only one age, and they do not share any names nor ages. | **Example: Not a Functions**   * This is **not a function** because John is paired with **two different ages** (25 and 30), which violates the rule that each input must have only one output |

**Every Possibility of Functions and Relations:**

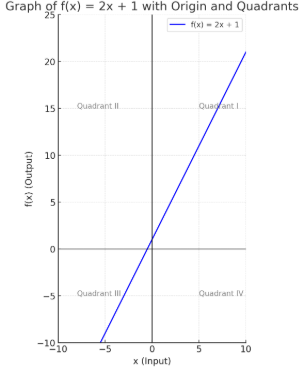
|  |  |  |
| --- | --- | --- |
| **Example 1: Multiple inputs, each with different outputs**   * **Input 1 → Output 2** * **Input 2 → Output 3** * **Input 3 → Output 4**   This **is a function** because each input (1, 2, 3) has exactly one output (2, 3, 4), even though there are multiple inputs. | **Example 2: Same input with multiple outputs**   * **Input 1 → Output 2** * **Input 1 → Output 3** * **Input 2 → Output 4**   This **is not a function** because **input 1** has **two outputs** (2 and 3), which violates the rule that each input must have only one output | **Example 3: Different inputs, same output**   * **Input 1 → Output 5** * **Input 2 → Output 5** * **Input 3 → Output 5**   This **is a function** **all the inputs** (1, 2, 3) have the **same output** (5), but each input still has **only one output.** |

**Ways a Function Can be Represented:**

* **Table of Values** – A **table of values** shows how inputs are matched to outputs. **Left row** represents the **independent variable**, and the **right row** represents the **dependent variable**.
* **Example:**

|  |  |  |
| --- | --- | --- |
| **Input** | **Output** | Each X-value is paired with exactly one Y-value. This is a function. |
| 1 | 3 |
| 2 | 5 |
| 3 | 7 |
| 4 | 9 |

* **Set of Ordered Pairs** – A function can be shown as a **list of ordered pairs**. Each pair has two numbers: The first number is the **input** (x). The second number is the **output** or .
* This is also called a **relation** — but it’s only a **function** if **each input appears only once**.
* **Example:**
* **Graphs** – A **graph** shows a function as a set of points on a grid, where: The **horizontal axis** represents the **input values** . The **vertical axis** represents the **output values** or .
* **Example:**
* It makes a **straight line**, and it passes the vertical line test. It is a function.



* **Equation or Rule** – A function can be described using a **mathematical equation** that gives the **rule** for how to get from the input to the output.

|  |
| --- |
| **Example:** |

**Slope of a Line**

**Slope:**

* **Slope** – A **line of measurement of steepness of a certain line**. Given two points on a line, the slope is the ratio of the vertical change or rise between the points and the horizontal change or run between the points. It is calculated by: Where is slope
* **Positive Slope** - The line **rises from left to right**. As you go right, the y-values also increase.
* **Example:** Line through and

|  |
| --- |
|  |

* **Negative Slope –** The line **falls from left to right**. As you move rightward along the x-axis, the y-value decreases.
* **Example:** Line passing through and

|  |
| --- |
|  |

* **Zero Slope (Slope of Zero)** - The line is **horizontal**. The y-values remain the same as x changes
* **Example:** Line through and

|  |
| --- |
|  |

* **Undefined Slope** - The line is **vertical**. The x-values stay the same, while the y-values change. Division by zero occurs.
* **Example:** Line through and

|  |
| --- |
|  |

**Slopes in Linear Equations:**

* **Linear Equation –** An algebraic equation where each variable has an exponent of 1, and when graphed, it forms a **straight line**. A linear equation can have **one or more variables**. In two-dimensional space, a linear equation with two variables (like x and y) represents a straight line.

|  |  |  |  |
| --- | --- | --- | --- |
| **Example 1:** | **Example 2:** | **Example 3:** | **Example 4:**  **Notes:**  To divide by a fraction, **multiply by its reciprocal**. And when you multiply a whole number to a fraction it becomes numerator and the denominator is 1 |

**Summary of Equations of Lines:**

|  |  |  |
| --- | --- | --- |
| **Form:** | **Equation:** | **Data Required:** |
| **Standard Form** |  |  |
| **Point-slope Form** |  |  |
| **Linear Slope** |  |  |
| **Two-point Formula (General Formula)** |  | are points on the line |
| **Intercepts Form** |  |  |
| **Horizontal Line** |  |  |
| **Vertical Line** |  |  |

**Functions:**

|  |  |
| --- | --- |
|  |  |
| * **Constant Function –** The output is always the same constant value, regardless of the input. |  |
| * **Linear Function** –The output increases or decreases at a constant rate, forming a straight line. |  |
| * **Quadratic Function** – The output grows proportionally to the square of the input, forming a parabolic curve that opens upward. |  |
| * **Cubic Function** –The output increases or decreases faster than a linear or quadratic function, creating an S-shaped curve. |  |
| * **Quartic Function** – Similar to a quadratic, but with flatter edges and steeper growth, it creates a symmetric W- or U-shaped curve. |  |
| * **Quintic Function** – A higher-degree polynomial that changes direction up to four times, producing complex S-like shapes with steeper slopes. |  |

**Miscellaneous**

**General Rules of Fractions:**

|  |  |
| --- | --- |
|  |  |
| * **Fraction** **–** Represents a part of a whole, with the **numerator** on top and the **denominator** below. |  |
| * **Proper Fractions** – Have **numerators** smaller than their **denominators**. |  |
| * **Improper fractions** – Have **numerators** greater than or equal to their **denominators**. |  |
| * **Mixed numbers** – Combine a **whole number** with a **proper fraction**. |  |
| * **Equivalent fractions** – Have different forms but the **same value**. |  |
| * **Simplifying** – To simplify a fraction, divide the **numerator** and **denominator** by their **greatest common factor**. |  |
| * **Adding Fraction with Same Denominator** – To **add fraction** with the **same denominator**, **add** the numerators and **keep** the denominator. |  |
| * **Adding Fractions with Different Denominator** – To **add fractions** with **different denominators**, find the **least common denominator**, **convert**, then **add**. |  |
| * **Subtracting Fractions with Same Denominator** – To subtract **fractions** with the **same denominator**, **subtract** the numerators and **keep** the denominator. |  |
| * **Subtracting Fractions with Different Denominator** – To **subtract fractions** with **different denominators**, make the denominators the **same** before subtracting. |  |
| * **Multiplying** Fractions – To multiply **fractions**, **multiply** the numerators and **multiply** the denominators. |  |
| * **Dividing Fractions** – To **divide fractions**, **multiply** the first fraction by the **reciprocal** of the second. |  |
| * **Conversion of Mixed to Improper** – To **convert a mixed number to an improper fraction**, **multiply** the whole number by the denominator, then **add** the numerator. |  |
| * **Conversion of Improper to** Mixed – To **convert an improper fraction to a mixed number**, **divide** the numerator by the denominator. |  |
| * Any number **divided by itself** is equal to **1**. |  |
| * Any number **divided by 1** stays the **same**. |  |
| * **Zero divided** by any number is **0**, but any number **divided by zero** is **undefined**. |  |