Worksheet 2:

Integrated Math & Quantum Challenge:

Bob and the Quantum Vault

Name: _____ Date: _____

Section 1: The Passage (The Riddle)

Bob stood in the silent vault room, sweat beading on his forehead. In front of him glowed the lock: the Quantum Vault, guarded by a single, flickering electron known as the **Qubit**. To open it, he needed the Qubit's secret Spin code.

He clutched a crumpled, torn-out piece of paper—the key to the puzzle. The paper gave him the rules of the electron's Spin, which meant the code could be one of two states: Spin Up (represented by the percentage **α**, or Alpha) or Spin Down (represented by the percentage **β**, or Beta).

Bob recalled that in the Classical Model, an electron was like a definite light switch: it could only be α **OR** β. However, the torn paper required **both α and β simultaneously**. This quantum difference was the key! He remembered that in the Quantum World, the electron is a Quantum Energy Wave and uses **Superposition**—it is in α **AND** β states at the same time!

The paper's first complete clue was the fundamental **100% Rule**. This rule is necessary because the electron must be found in one of those two states when measured:

Clue 1: $\alpha\% + \beta\% = 100\%$

Bob's mission is to use Algebra and Probability to figure out how this Quantum Rule allows him to open the Quantum Vault.

Section 2: Math and Probability Integration (The Code Calculations)

Use Clue 1 and your knowledge of Algebra and Percentages to help Bob solve the code.

A. Probability and Percentage: A Qubit is prepared with an α percentage that gives it a 72% chance of being Spin Up when measured.

1. What is the β percentage chance of finding the Qubit Spin Down? (Show your work using Rule 1)
   $\beta\% = 100\% - 72\%$
   Answer: β% = _____
2. If a scientist measures this Qubit 50 times, how many times would the result likely be Spin Up (α)?
   $50 \text{ times} \times 0.72 = \text{number of times}$
   Answer: _____ times

B. Basic Algebra (Solving for X): Bob finds a note showing the code percentages are related: the α percentage for Spin Up is represented by a variable, X. The β percentage for Spin Down is X+20.

1. Set up the equation using the 100% Rule:
   $X + (X + 20) = 100$
2. Solve for X (the α percentage). Show your steps!
   $2X + 20 = 100$
   $2X = 80$
   X = _____ (the α%)
3. What is the β percentage in this experiment?
   Answer: β% = _____

C. Advanced Probability (Code Check): If the α percentage gives the Qubit a 4/5 probability of being Spin Up.

1. What is the probability (as a fraction) that the Qubit will be found Spin Down (β)?
   Answer: _____
2. Convert the β probability into a percentage.
   Answer: β% = _____

Section 3: Inferential Comparison (The Missing Clue)

Use the mathematical rules and the story context to explain why the Quantum Model is the only way Bob can succeed.

1. **The Code Mystery:** Bob saw α and β written on the paper. Infer: If the electron were following the Classical Model (like a single light switch), why would the paper showing **both α and β** be a contradiction that leads to the alarm going off?

2. **The Proportional Defect:** The old particle model was unstable. How does the electron being a **Quantum Energy Wave** (which requires the α%+β%=100% rule) provide the necessary stability that the old orbiting particle model lacked?

3. **Opening the Vault (Synthesis):** Imagine the final lock sequence requires checking 20 different codes. Justify: If Bob uses the Qubit's **Superposition** (both α and β simultaneously) instead of the classical 'guess-and-try' method, how does the Quantum Rule provide the **immediate, fastest solution**? (*Hint: Think about processing all codes at once.*)