

HZT4UE – Theory of Knowledge

UNIT 5: MATHEMATICS – Review Sheet

Three themes: i) abandon common sense / intuition; ii) math in nature; iii) math comes first

1. Explain the difference between inductive vs. deductive logic. What type does mathematics use? How does this affect knowledge gained through mathematics?
2. How does one prove a theorem? How many cases must be tested in order to "prove" the validity of the theorem?
3. Illustrate how mathematics can be superior to common sense in certain cases.
4. What is meant by calling mathematics a language? What does it describe? How well does it interact with our spoken or written language?
5. What are Fibonacci numbers? Give some examples from nature. What did Fibonacci numbers suggest about mathematics and nature? What is the golden ratio (PHI) ? Relate the golden ratio of Fibonacci to beauty.
6. What is non-Euclidean geometry? Which postulate of Euclid is questionable? What implications does this have for the structure of the universe? Who formulated these alternate views?
7. How supportable is the claim that mathematics is infallible? Does $1 + 1 = 2$? How does mathematics fit in with 'the real world'.. Link this to review question #3.
8. Be able to explain any of the "new physics" terms: double slit experiment, particle-wave duality, Copenhagen Interpretation, quantum, Schrodinger's cat, particle accelerators like CERN and Fermilab, quantum logic/ polarized light, implications of Relativity, twin paradox, Heisenberg Uncertainty Principle
9. What are some examples of where mathematics produced a purely deducive form of knowledge but it could not be proven through observation/experimentation until later? Be able to provide at least two examples.
10. Explain how mathematics produces a unique kind of knowledge using axioms and deductive reasoning. What are the other essential elements of mathematics? They are: 1. use of basic concepts (like: point, number, line, complex and negative numbers....). 2. abstraction. 3. idealization. 4. use of symbols. 5. seems to describe nature.
11. What is chaos theory? What is the Lorenz attractor; be able to draw it. Using examples, what does chaos theory suggest about the limits of mathematical knowledge. Is there order in chaos? Explain.
12. Explain what Godel's theorem is and its implications for mathematics.
12. From the YouTube videos called "The Elegant Universe" - Have a basic idea of how string theory tries to unify quantum mechanics and relativity but has problems being believed.