

The Elegant Universe

Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory

Part 1: Einstein's Dream

1. Who began searching for the "Theory of Everything" over 50 years ago?
2. What one (1) kind of ingredient is all of the matter in the Universe believed to possibly be made of?
3. What is a string?
4. What is "Unification"?
5. Why do physicists believe that unification is possible?

Force #1: Gravity

6. Newton didn't invent gravity. What did he say about it in 1665 to unify the heavens and the Earth?
7. According to Newton, what would happen to the planets if the Sun was vaporized? How long would it take for the planets to feel this change?
8. How long does it take sunlight to travel from the Sun to the Earth?
9. According to Einstein, when would the Earth feel the effect of the Sun's destruction?
10. What did this mean about Newton's theory of gravity?
11. What is space-time?
12. How does space-time create gravity?

13. According to the theory of space-time, if the Sun was vaporized what would be created by the Sun's sudden disappearance?

14. How long would it take for it to affect the Earth?

15. What would happen to the Earth?

16. What did Einstein call his theory of space-time?

Force #2: Electromagnetism

17. Who unified electricity and magnetism?

18. How many simple equations did he need to unify them?

19. As a result of this unification, the speed of gravity is also the speed of what?

20. Which is stronger: gravity or electromagnetism?

21. Why is it stronger?

22. How much stronger is it?

23. Einstein's and Maxwell's theories tried to explain the world of atomic particles - protons, neutrons, and electrons - in a predictable way but Niels Bohr and his colleagues discovered that these theories don't work at the atomic level. What new theory could explain the subatomic world?

24. Classical (Newtonian) and General Relativity (Einsteinian) physics were ruled by predictability. What rules the quantum world? What's the best you can hope for in the quantum world?

25. The quantum world gives rise to alternate universes. Why do alternate universes occur?

Forces #3 & #4: Strong Nuclear Force & Weak Nuclear Force

26. Describe the:

a) Strong Nuclear Force =

b) Weak Nuclear Force =

27. What event first released the Strong Nuclear Force?

28. Both the Strong and Weak Nuclear forces are VERY strong - much, much stronger than Gravity and Electromagnetism. Why are they so much stronger?

29. In a nutshell:

- a) General Relativity is the physics of the very _____ and
- b) Quantum Mechanics is the physics of the very _____.

30. During WW I (1916), Karl Schwarzschild began solving Einstein's equations in a new and different way. His efforts resulted in the description of something called a 'black hole.' A black hole creates a new dilemma for General Relativity and Quantum Mechanics. Describe what a black hole is and what the dilemma is.