ZERO Chapter 8 Reading Questions Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. General relativity is the theory of the very, very \_\_\_\_\_\_\_\_\_\_ while quantum mechanics is the theory of the very, very \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

2. Some objects, such as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, appear in both theories.

3. The universe of general relativity can be described as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sheet; that of quantum mechanics can be described as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

4. In a black hole, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are meaningless.

5. The electron is a \_\_\_\_\_\_\_\_\_\_\_\_\_ - dimensional object of unknown \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. When a scientist measures the electron in the laboratory there are errors in the measurement. The “true” electron is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and carries a greater \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than the observed electron.

6. String theory is a new field that attempts to deal with the troubles of **renormalization**, meaning the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mass and charge of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. If an electron is thought of as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of string, then the singularity point where the particles merge is smoothed out.

7. In string theory, different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are really the same type of string, just \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in different ways. With this theory, the problems between general relativity and quantum mechanics are no longer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. However the hope of a “Theory of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” was found to require \_\_\_\_\_\_\_\_\_\_\_\_ dimensions, which are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ up like little balls. Like imaginary numbers, we can’t see/feel/smell them but they are necessary for doing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

8. What is the main objection to string theory?

9. While string theory might be mathematically \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, it is not yet \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

10. Einstein felt his general theory of relativity had a fatal flaw – it foretold the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. There were two choices: the universe would \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or it would \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. But Einstein felt the universe was \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. So he added a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to his theory to “correct” it.

11. Edwin Hubble found a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Cepheid star that proved that the universe was \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of times bigger than suspected. He also found that the universe was expanding and that the farther away the galaxies were, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ they were moving away.

12. The Big Bang theory posits a singularity at the beginning of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The steady state theory proposes that the universe as a whole is in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and constantly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ itself.

13. In the year \_\_\_\_\_\_\_\_\_ astrophysicists at Princeton University discovered \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which is the afterglow of the big bang. For their efforts they were awarded the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.