Name _____ Date _____

Regents Physics Modern WS #4R

Period _____ Mrs. Nadworny

(25 pts)

# The Standard Model

**Directions:** Read online textbook pages 896 – 901 & 917 – 925. Then go to http://www.particleadventure.org, under "The Standard Model" click "GO!" to begin. Use the arrows in the top right corner to work your way through the information. Answer the following questions to the best of your ability, using the information from the website. This website uses pop-ups. It is best viewed with Internet Explorer.

1. Define fundamental:

   _____

   _____

2. In ancient times, people believed that the world was made of 4 elements. List them

   _____, _____, _____ _____

3. Why is the term "atom" a misnomer?

   _____

   _____

   _____

4. Are atoms fundamental?

   _____

5. The nucleus is made of _____ and _____.

6. The fundamental particles that make up protons and neutrons are called _____.

7. Describe the modern atom model:

   _____

   _____

   _____

8. A rough estimate of the size of a quark is _____ m.

9. The Standard Model explains

   _____

   _____

   _____

Continued on next page

10. List the three main parts of the Standard Model
_____, _____, _____

11. The hundreds of particles known to human kind are made up of how many fundamental particles? _____
_____
_____

12. For each type of **matter particle** there exists a corresponding _____

13. What happens when a matter particle and an antimatter particle collide?
_____

14. The electron is a matter particle. The _____ is the antimatter particle of the electron.

15. Why is there more matter than antimatter in the universe?
_____

16. The quark exists in 3 pairs. List the three pairs AND their charge.
_____
_____
_____

17. The top quark was discovered in _____-

18. The word QUARK comes from what author? What book?
_____

19. What is unusual about the charge of quarks?
_____

20. Composite particles made of quarks are called _____, which always have a(n) _____ charge.

21. Baryons contain _____

22. A proton is a baryon made up of what combination of 3 quarks? _____

23. A neutron is a baryon made up of what combination of 3 quarks? _____

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24. Mesons contain _____

25. Mesons are unstable because
_____
_____

26. The best known lepton is _____

27. The other two charged leptons are called _____ and _____

28. The three neutral leptons are called _____

29. Quarks and leptons are both fundamental particles. A difference between them is
_____
_____

30. We don't see heavy leptons, tau and muon, in ordinary matter because
_____
_____

31. Since neutrinos have no _____ or _____, they rarely interact with other particles.

32. What are protons made of? _____

33. What are electrons made of? _____

34. List the four fundamental interactions that occur between particles
_____, _____, _____ _____

35. The particles which carry interactions are called _____.

36. At a fundamental level, a force is a thing which _____.

37. In the animated diagram of the two people on the ice pond, the repulsive force is provided by passing a basketball back and forth. The basketball acts like a **"force carrier particle"**

This is an example of Newton's _____ Law, which states that "For every action
_____
_____

38. The electromagnetic force causes _____ to repel and _____ to attract.

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39. The carrier particle for the electromagnetic force is the _____.

40. Photons have _____ mass and travel at the speed of _____.

41. The _____ allows atoms to bond and form molecules.

42. What force keeps the positive protons in the nucleus from exploding apart?

    _____

43. The force carrier particles of the strong force are called _____ because they hold quarks tightly together.

**SKIP PAGES ABOUT COLOR CHARGE (Pick up again at the Residual Strong Force page)**

44. In the nucleus, the _____ force between quarks is big enough to overcome the repulsive electromagnetic force.

45. Weak interactions are responsible for

    _____

    _____

46. The carrier particles for the weak interaction are _____, _____, and _____

47. In the Standard Model the weak and electromagnetic interactions have been combined into a unified _____ theory.

48. The predicted force carrier particle for gravity is called the _____.

Comparative strength of the four forces: Strong >> Electromagnetic, Weak >> Gravity

49. Which of the four forces is responsible for
    a. Friction? _____
    b. Nuclear bonding (holding a nucleus together)? _____
    c. Planetary orbits? _____