

Week 33 – Modern Physics

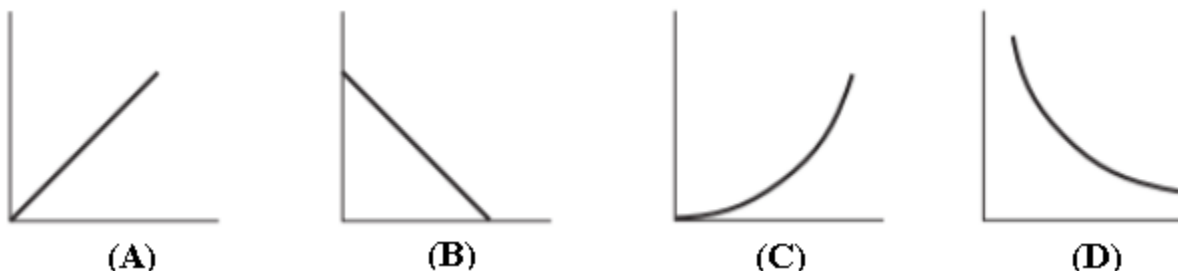
Read Page 357-359 (Mass-Energy Equivalence)

TQ1. In 1905, Albert Einstein proposed that an object's mass is a measure of what?

TQ2. What does the single law of conservation of mass-energy state?

TQ3. What is Einstein's famous equation?

TQ4. Which graph below best represents the relationship between energy and mass when matter is converted into energy?



QQ4. What is the energy of one electron ($m = 9.11 \times 10^{-31}$ kg) in Joules?

TQ5. Where do we get the 1u or universal mass unit?

TQ6. What is the force of nature that holds the nucleus together even though the two protons have positive electrical charges?

TQ7. What is the energy called that is necessary to break the nucleus apart?

TQ8. What is the equation for the binding energy of the nucleus?

TQ9. Determine which of the following nuclear reactions is fission and which is fusion:

- Reaction #1: ${}^2_1\text{H} + {}^2_1\text{H} \rightarrow {}^3_2\text{He} + {}^1_0\text{n} + \text{Energy}$
- Reaction #2: ${}^1_0\text{n} + {}^{235}_{92}\text{U} \rightarrow {}^{141}_{56}\text{Ba} + {}^{92}_{36}\text{Kr} + 3 {}^1_0\text{n} + \text{Energy}$

Read Page 362 and 364 (The Standard Model)

TQ10. What is antimatter?

TQ11. What is the antimatter of a proton? What is the antimatter of an electron?

QQ12. An electron and a positron collider and completely annihilate each other. How much energy is released? (mass of an electron = 9.11×10^{-31} kg)

TQ13. What are the four fundamental forces of matter from strongest to weakest?

CQ14. Label each one of the examples with one of the four fundamental forces of matter:

- The force of attraction between the Earth and the moon
- The force of attraction between a proton and a neutron

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- The force of attraction between a proton and an electron
- The force responsible in a nuclear fission reaction

TQ15. All matter is divided into what two major classifications?

TQ16. Protons and neutrons are made up of hadrons which are made up of baryons and mesons. These are made up of elementary particles called quarks. What are the names of the six types of quarks and antiquarks?

Read Pages 368-369 (Einstein's Relativity)

CQ17. Jimmy and Johnny are twin brothers. Jimmy goes up into space at 90% of the speed of light for 5 light years and then returns to Earth. Jimmy comes back in just under 10 years and has aged approximately 10 years. Johnny remains here on Earth during that whole time. Did Johnny get 10 years older during that time? Why or why not?