Physics 90 Exam for Unit 3 — SOLUTION

April 17, 2020

1. Free Fall and Newton's Second Law of Motion

(D) 784 Newtons

2. Circular Acceleration

(C) 1.25 m/s^2

3. Newton's Third Law of Motion

(B) 20 Newtons of force

4. Newton's Universal Law of Gravitation, Elevator

(D) You, the coffees and the elevator car will all fall together as if weightless, even though gravity is still pulling on everything.

5. Newton's Universal Law of Gravitation, Space Station

(B) the ISS is falling in a circle around the Earth and the ISS, Chris Hadfield, and his guitar are all in free fall together. (An understanding of problem 4 is very much supposed to help you understand problem 5.)

6. Newton's Universal Law of Gravitation, Proportional Reasoning

(C) 1 pound of force (double the height, 1/4 the force)

7. Mass of Water in a Swimming Pool

(C) 3125000 kg

8. Mass and Density of the Planets

(D) Saturn / less

9. An Imaginary New Planet

(B) About half rock, like the four inner planets, and half compressed gas, like the four outer planets. (I made the density work out to about half way between the inner and outer planets — the idea was to recognize that this planet is most likely half-and-half the composition.)

10. Energy and Power

(A) 9×10^{11} Joules

11. Intensity

(A) 105 Watts

12. Fission and Fusion

(C) Iron

13. Ivy Mike Fusion Bomb and $E = mc^2$

(A) 0.5 kg

14. Elements and the Periodic Table

(D) 36 protons and 49 neutrons

15. The Size of the Sun

(B) The diameter of the Sun is: $\frac{150{,}000{,}000\ \text{km} * 0.54^\circ}{57.3^\circ} = 1\,400\,000$ km

16. The Amount of Hydrogen in the Sun

(B) 10^{57}

17. Nuclear Energy in the Sun

(A) 0.43×10^{-11} Joules

18. Nuclear Energy in the Sun Again

(B) Fusion, and light elements like Hydrogen are turned into heavier elements like Helium.

19. The Structure of the Sun

(C) The rising currents of water in a pot of water that is about to boil is an example of convection.

20. Structure of the Sun Again

(D) photosphere