Quiz 7; Phys 100 Name _____

1 kiloton = 4.2×10^{12} J. Gravitational Energy = Weight $\times$ height

1. (4 points) Which of the following makes fusion difficult to achieve at low temperatures?

(a) The electromagnetic repulsion between protons

(b) The large mass of nuclei beyond iron in the periodic table

(c) Beta decays due to the weak nuclear force

(d) Gravity being a very weak force at small distances

(e) Metric α-tensors expanding throughout the reticulum

2. (4 points) Which of the following is *not* a problem associated with nuclear power derived from fission?

(a) Disposal of radioactive waste

(b) Possibility of diverting the technology to violent use

(c) Intensive production of gases that cause global warming

(d) Environmental damage due to mining fissionable materials

(e) Possibility of accidents in nuclear power plants

3. (4 points) How high could the energy of a 15-kiloton atomic bomb lift the US population, assuming a population of 300 million with an average weight of 600 N (mass of 60 kg) per person? How high could a 15-megaton hydrogen bomb lift the US population?

Answer: 15 kilotons is $15 \times 4.2 \times 10^{12} = 6.3 \times 10^{13}$ J. The total weight to be lifted is $3 \times 10^8 \times 600 = 1.8 \times 10^{11}$ N. Therefore the height is

$$\text{height} = \frac{\text{Energy}}{\text{Weight}} = \frac{6.3 \times 10^{13}\ \text{J}}{1.8 \times 10^{11}\ \text{N}} = 350\text{m}$$

A 15-megaton bomb means multiplying the result by 10^3, resulting in 350 km—over two hundred miles!

4. (4 points) Radio telescopes are very large compared to telescopes that observe visible light. Why?

(a) The atmosphere is not as transparent to radio waves as to UV light

(b) They need to overcome interference from commercial radio stations

(c) Hydrogen in the atmosphere makes focusing difficult in small dishes

(d) The wavelength of radio waves is much larger than visible light

(e) Small dishes reverse the polarity of the neutron flow

5. (4 points) Why does quantum randomness *not* put questions about free will and the laws of physics to rest?

Answer: Quantum mechanics introduces a fundamental randomness into physical processes, which means that our choices may not ever be completely predictable, or determined by prior conditions. But a random element in the results is is not what is meant by the extreme "libertarian" version of free will, in which free human decisions are entirely outside the realm of physics.