**Energy & Momentum homework problems (Physical Science)**

Name and date submitted (3 pts):

Instructions: Using this form as a template, create space in the document below and write or type your answers. Turn in your completed work as an email attachment.

(10 questions, 100 points possible).

Formulas

Potential energy (J) PE = mgh m is mass in kg, g is gravitational acceleration (9.8 m/s2), h =height in m

Kinetic energy (J) KE = ½ mv2 m is mass in kg, v is velocity in m/s

Momentum (kg-m/s) p = mv p is momentum, m is mass in kg, v is velocity in m/s

Nuclear energy (J) E = mc2 E is energy released in J, m = mass converted to energy, c = speed of

light 3.0 x 108 m/s

1. You carry a 2-kg Physics book to the top of a 3-story building. The height is 30 m. How much potential energy in Joules have you imparted to the book? (hint: 500-600 J)
2. Now you drop the same Physics book off the 3rd-story and it lands on the sidewalk below. What is its kinetic energy in Joules the instant before it hits the sidewalk? (hint: use the law of conservation of energy PE = KE)
3. Using the kinetic energy formula, calculate the book’s velocity the instant before it hits the sidewalk. (Hint: use KE = ½ mv2… 20-25 m/s)
4. Momentum is conserved: A ham, relish, and mustard sandwich with a mass of 0.5 kg comes sliding down the lunch counter from left to right at a velocity of 5 m/s. It collides with a stationary (v = 0 m/s) hot chili cheeseburger with a mass of 1.0 kg, and the combined stuck-together pile moves down the lunch counter from left to right. What is the pile’s velocity? (hint: use p = mv to compute the beginning momentum of each sandwich. Then use “conservation of momentum” which states that the sum of the two individual momentums must equal the momentum of the final pile. The final pile’s velocity will fall out of the equation. Remember that the ‘mass’ of the pile is greater. Answer is between 1.5 and 2.0 kg-m/s)
5. Nuclear energy: In a nuclear power plant, Uranium (U-235) is bombarded with neutrons and splits apart into smaller fission products, in the process releasing energy according to Einstein’s equation E = mc2. In a typical nuclear reactor, each kg of U-235 fuel ends up converting 0.0009 kg of its mass into energy. That is to say, you start with 1.0000 kg of U-235 fuel and end up with just 0.9991 kg of fission products. Putting it still another way, each kg of U-235 fuel converts 0.0009 kg of its mass to energy according to E = mc2. In the equation, ‘c’ is the speed of light in a vacuum, 3.0 x 108 m/s. How much energy in Joules is produced for each kg of U-235 fuel ‘burned’? (hint: slightly more 8.0 x 1013 J and slightly less than 10.0 x 1013 J)
6. Coal power: the energy value of coal is around 5.0 x 107 J/kg (it varies). That means burning a kg of coal in a power plant will produce around 5.0 x 107 J of energy. How many kilograms of coal would you need to burn in a power plant to produce the same amount of energy produced by just 1 kg of Uranium-235 in the nuclear reaction in the above question? (hint: take the Uranium total energy and divide by the energy value of coal. Answer is between 1 million and 2 million kg coal)
7. If you lift a 4.00 kg book a distance of 2.00 m and place it on a shelf, how much potential energy have you given to the book? Formula: PE = mgh. (75-100 J)
8. What would the kinetic energy be of a 5.000 kg rock thrown through the air with a velocity of 15.00 m/s? Formula: KE = ½ mv2. (500-700 J)
9. What is the momentum of a bullet traveling at 300 m/s if its mass is 0.002 kg? (0.5-1.0 kg-m/s)
10. A 1500-kg car has a momentum of 37,500 kg-m/s. What is its speed? (20-40 m/s)