Energy Problems (Kinetic and GPE) Key

Work the following problems on a separate sheet of paper – use the 4 steps for solving physics problems.

KE = ½ m x v^2 GPE = m x g x h

1. A cheetah can run briefly with a speed of 31 m/s. Suppose a cheetah with a mass of 47 kg runs at this speed. What is the cheetah's kinetic energy?
   31 m/s = v KE = ½ m x v^2 KE = 23.5 x 961
   47 kg = m KE = ½ (47) x $(31)^2$ KE = 22583.5 J or 2.3 x 10^4 J
2. A table tennis ball has a mass of about 2.45 g. Suppose the ball is hit across the table with a speed of 4.0 m/s. What is the ball's kinetic energy?
   4.0 m/s = v KE = ½ m x v^2 KE = 0.001225 x 16
   2.45 g = m KE = ½ (0.00245) x $(4.0)^2$ KE = 0.00196 J or 2.0 x 10^{-2} J
3. A baseball traveling at a speed of 35 m/s has 89 J of kinetic energy. What is the mass of the baseball?
   35 m/s = v KE = ½ m x v^2 89 = m x 1225
   89 J = KE 89 = ½ (m) x $(35)^2$ m = 0.15 kg
4. A meteoroid entering Earth's atmosphere has a speed of 70.0 km/s and a kinetic energy of 2.56 x 10^{15} J. What is the mass of the meteoroid?
   70.0 km/s = v KE = ½m x v^2 2.56 x10^{15} = ½ (m) x 4.9 x 10^9
   2.56 x10^{15} J= KE 2.56 x 10^{15} = ½ (m) x $(70000)^2$ KE = 1.04 x 10^5 J
5. The kinetic energy of a golf ball is measured to be 143 J. If the golf ball has a mass of 47g. What is its speed? (hint: rearrange the equation for kinetic energy to solve for v. the equation will involve a square root
   143 J = KE KE = ½ m x v^2 KE = x
   2.45 g = m KE = ½ () x $()^2$ KE = J or x 10^4 J
6. When a 65 kg skydiver jumps from a plane, her speed steadily increases until air resistance provides a force that balances the force due to free fall. How fast is the skydiver falling if her kinetic energy is 7.0 x 10^5 J?
   4.0 m/s = v KE = ½ m x v^2 KE = x
   2.45 g = m KE = ½ () x $()^2$ KE = J or x 10^4 J
7. A 725 kg car has a kinetic energy of 302 kJ as it travels along a highway. What is the car's speed?
   4.0 m/s = v KE = ½ m x v^2 KE = x
   2.45 g = m KE = ½ () x $()^2$ KE = J or x 10^4 J
8. What is the gravitational potential energy associated with a 75 kg tourist at the top floor of the Sears Tower in Chicago, with respect to the street 436 m below?
9. An Olympic diver weighing 650 N is on a platform 10 m above the water. What is the diver's gravitational potential energy with respect to the water?
   (Hint: m x g = weight in N or F_g)
10. A bird carries a 25 g oyster to a height of 11 m. What is the gravitational potential energy of the oyster?

11. The bird from problem 10 drops the oyster. As it falls, all of the gravitational potential energy is transformed into kinetic energy (air resistance is negligible). What is the speed of the oyster when it hits the ground?
12. The world record for pole vaulting is 6.15 m. If the pole vaulter's gravitational potential at his maximum height was 4942 J, what was his mass?
13. An automobile to be transported by ship is raised 7.0 m above the dock. If its gravitational potential energy is 6.5×10^4 J, what is the automobile's mass.
14. An Olympic high-jumper with a mass of 82.0 kg has a gravitational potential energy of 1970 J at the peak height of the jump. How high is the jump?
15. A 1750 kg weather satellite moves in a circular orbit with a gravitational potential energy of 1.69×10^{10} J with respect to Earth's surface. At its location, free-fall acceleration is only 6.44 m/s^2. How high above Earth's surface is the satellite?