

1. The force exerted by a non-linear spring is given by $F(x) = 3x^3$ [N]. What is the change in elastic potential in the spring when it is stretched from 3 [m] to 8 [m]?
2. A bullet of mass 1 [kg] is fired into a block of wood of mass 291 [kg] that is fixed in place. The velocity of the bullet the instant before it impacts the block is 279 [m/s]. The bullet enters the wood block and experiences a frictional force $F = -51v$ [N].
3. A bullet of mass 1 [kg] is fired into a block of wood of mass 220 [kg] that is fixed in place. The velocity of the bullet the instant before it impacts the block is 3570 [m/s]. The bullet enters the wood block and experiences a frictional force $F = -678v$ [N]. Calculate the DISTANCE the bullet travels inside the wood block before it comes to a stop.

(Hint: write a differential equation to obtain $v(t)$. Then from $v(t)$, you can derive $x(t)$ as t goes to infinity)
4. Zero, a hypothetical planet, has a mass of 3.0×10^{23} [kg], a radius of 3.0×10^6 [m], and no atmosphere. A 11 [kg] space probe is to be launched vertically from its surface.
 - a. If the probe is launched with an initial kinetic energy of 5.0×10^7 J, what will be its kinetic energy when it is 4.0×10^6 [m] from the center of Zero?
 - b. If the probe is to achieve a maximum distance of 8.0×10^6 [m] from the center of Zero, with what initial kinetic energy must it be launched from the surface of Zero?
5. A spaceship is on the surface of a spherical asteroid. The gravitational acceleration on the surface of the asteroid is 2.9 [m/s²].
 - a. What is the escape speed from this spherical asteroid if its radius is 500 [km]?
 - b. How far from the surface will a particle go if it leaves the asteroid's surface with a radial speed of 1000 [m/s]?
 - c. With what speed will an object hit the asteroid if it is dropped from 1000 [km] above the surface?

HW Set 7 Answers

- 1. 3011.25 [J]
- 2. 169.22 [m/s]
- 3. 5.26 [m]
- 4a. 3.17×10^7 [J]
- 4b. 4.59×10^7 [J]
- 5a. 1700 [m/s]
- 5b. 2.63×10^5 [m]
- 5c. 1390 [m/s]