MAC1105 Week 10 Discussion

Module 10: Modeling

October 24, 2019

(1) In physics, the potential energy (p) of an object varies directly with the mass of the object (m) times the height of the object (h) times a constant (g).

- (a) Write the expression for potential energy.
 - **Answer**: p = mgh
- (b) An object that weighs 55 kilograms and is at a height of 121 meters above sea level has a potential energy value of 65285.55 joules. Determine the value of the constant, g.

Answer: g = 9.81

(c) Write an equation to express the height of this object in terms of its potential energy, assuming that its mass remains constant at 55 kilograms.

Answer:
$$h = \frac{p}{539.55}$$

(2) Gravity exists between any two objects with mass, not just when planets are involved. In physics, the force of gravity (F) is given by the following equation:

$$F = \frac{GMm}{r^2}$$

where G is a constant, M is the mass of the one object, m is the mass of the other object, and r is the distance between both objects. Suppose Jon Snow is celebrating his birthday with a large chocolate cake. Jon weighs 77 kilograms, and the cake weighs 2.3 kilograms. When Jon is 0.3 meters away from the cake, he feels a force of gravity equal to 1.3125×10^{-7} newtons.

(a) What type of relation exists between gravitational force (F) and the distance between Jon and his cake (r)? (i.e.- direct or indirect variation?)

Answer: Indirect Variation

(b) Determine the value of the gravitational constant, G, with the information given.

Answer: $G = 6.67 \times 10^{-11}$

(c) Jon wants to share some of his cake with Daenerys. Write an equation to express the distance between Daenerys and the cake (r) in terms of the gravitational force (F), assuming the cake's mass stays the same and with the knowledge that Daenerys weighs 52 kilograms.

Answer:
$$r = \frac{0.0000893}{\sqrt{F}}$$