PHYS 1511 Discussion Section: Week 6

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Review

Chapter 6: Work and Energy

- -Conservative Forces
- -Non-conservative forces
- -Conservation of Energy
- -Power w/ unit (Watts)

Chapter 7.1& 7.2: Work and Energy

- -Impulse
- -Momentum
- -Conservation of momentum

Relevant Equations

$$W = F * \Delta x * \cos(\theta) \qquad \text{(Work)} \tag{1}$$

$$KE = \frac{1}{2}mv^2 \qquad \text{(Kinetic Energy)} \tag{2}$$

$$PE = mgh \qquad \text{(Gravitational Potential Energy)} \tag{3}$$

$$KE_i + PE_i = KE_f + PE_f \qquad \text{(Conservation of Energy)} \tag{4}$$

$$W = \Delta KE = -\Delta PE \qquad \text{(Work-Energy Theorem)} \tag{5}$$

$$P = \frac{W}{\Delta t} \qquad \text{(Power)} \tag{6}$$

Relevant Equations

$$\vec{p} = m\vec{v} \qquad \text{(Momentum)} \tag{7}$$

$$\vec{J} = \vec{F}\Delta t = \Delta\vec{p} \qquad \text{(Impulse)} \tag{8}$$

$$\vec{P}_{total_i} = \vec{P}_{total_f} \qquad \text{(Conservation of Momentum)} \tag{9}$$

Question #1

Doing enough work

A Construction worker needs to move a wooden pallet 5m to the left. They apply an average force at an angle of 30° above the horizontal. During this time they do 400J of work. Find the following:

(a) The magnitude of the average amount of force applied to the pallet

(b) If it took the worker 2 seconds to accomplish this, how much power did they output to move the pallet?

(c) If the pallet started from rest and reached a final speed of 4.62 $\frac{m}{s}$ before suddenly stopping, what is the mass of the pallet? (Assuming a constant acceleration and no friction)

Question #2

Conservation Law

A child sits at rest on top of a slide preparing to go down. The child's final velocity at the bottom of the slide is 5m/s. Let the bottom of the slide be h=0. Answer the following:

(a) Find an expression for the total energy of the child at the top of the slide

(b) Find an expression for the total energy of the child at the bottom of the slide

(c) What is the height of the slide?

(d) If we don't ignore friction, how much work does friction do on the child if the child's final velocity was 4 m/s and m = 20kg? (be careful of signs)

Question #3

Projectile Theorem

A projectile of mass is shot straight up with an initial speed of 18.0m/s.

(a) How high would it go if there were no air resistance? (you do not need mass to solve this)

(b) If the projectile has 0.75kg mass and rises to a maximum height of only 11.8m what is the amount of work done by friction on the projectile? (be careful of signs)

Question #4

Impulsive

In a car crash, airbags are released in order to soften the force the steering wheel might apply to the driver.

(a) What physical quantity does the airbag reduce?

(b) Two test dummies of the same mass are in the same crash. Test dummy A has an airbag and dummy B does not. If dummy A takes six times longer strike the car than dummy B, what is the ratio of their forces? i.e. $\frac{F_B}{F_A} = ?$

(c) Based on your result for (b) are airbags a good idea?

Question #5

Build your momentum

Pretend the SpaceX Big Falcon Rocket (BFR) has already launched and in cruising towards Mars in space. The BFR has a mass of roughly 1.5×10^5kg without fuel. The rocket needs to adjust course so it shoots all of its 2000kg of burning rocket fuel out the back at a speed of 110 km/s. Before adjustment, the rocket was initially travelling at a speed of 15km/s. Find:

(a) The initial momentum of both the rocket and the fuel (be careful about mass)

(b) The final momentum of the fuel

(c) The final speed of the rocket