ENGR 1611 – Concepts I

Topic: Work and Power

Thursday 5th week

Mid-Term Evaluation

Lengsfeld’s results

• Lengsfeld does well at …

• Lengsfeld does terrible at ....
Outline

• What is work?
• What is power?
• What is efficiency?
• Why are these variables important?

Work

Work = Force \cdot Distance
Work

• No work is done if
  • the object is stationary
  • the force is perpendicular to the distance moved

• Units of Work
  • m·N = Joule SI System
  • ft·lbs US System

Work

\[ \text{Work} = \text{Force} \cdot \text{Distance} \]

What is the Work? What is the Force?
Work

Work = \text{Force} \cdot \text{Distance}

What is the Work? What is the Force?

Work and Efficiency

- Sometimes work is lost
  - More work is put into a system that is actually done.
  - Where does it go?
Work and Efficiency

• Sometimes work is lost
  • More work is put into a system that is actually done.
  • Where does it go?

  Friction, Heat

• The efficiency can then be determined by:

\[
\text{Efficiency} = \frac{\text{Work Output}}{\text{Work Input}}
\]

Efficiency

• The ideal efficiency = 1
  • No work is lost
  • All work input translates to work output

• Most efficiencies range between 0 and 1

• Can efficiency be greater than 1???
Exercise – Weight Machine

While PUMPING UP you attempt to lift a 150 lb weight to a height of 2 feet.

If friction causes the loss of 60 in-lb of work,

1. How much work must you actually supply?

2. What is the efficiency of the exercise?

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Power

- Power is the rate at which work is done

\[ \text{Power} = \frac{\text{Work}}{\text{Time}} \]

- Units of Power
  - m-N/s or Joule/sec \quad \text{SI System}
  - ft-lbs/s \quad \text{US System}
Power

- James Watt
  - Invented the steam engine
  - Developed horsepower
    - Based on measure that an average horse can pull 330 lb up 100 ft in 1 minute
- Relations
  - 1 hp = 550 ft-lb/s US System
  - 1 Watt = 1 m-N/s = 1 Joule/s SI System

Exercise – Weight Machine

While pumping up you attempt to lift a 150 lb weight to a height of 2 feet.

If friction causes the loss of 60 in-lb of work,

3. How powerful are you if you perform the exercise in 2 seconds?

4. How do you compare to a horse (hp)?
System Exercise

Shaft Radius $r$
What considerations?
Find: Power Out

Motor
Hp, $T$, $\omega$

Gear 1
$N_1$

Gear 2
$N_2$

W