Chapter 14 - 7

Conservation of Energy (Angular)

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Rotational Energy

- Rotational Energy can be written as U = Fs where a Force acts over a defined amount of circumference (s)
- U = F s but s = r θ, therefore
- U = F r θ but Torque = F x r , so
- U = Torque x θ

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Angular Energy

- Rotational Energy = Angular Energy
- Example 14-7
  - –The energy caused by a force applied on the perimeter for 3 revolutions (F x s) equals the angular energy lost by the rotating disk slowing down

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Conservation of Energy

- Typical Parameters
  - –Block B starts at rest
  - –Block B travels linearly (drops)
  - –Cylinder A accelerates
  - –Frictional Work may be involved

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Example 14-7

- Between two items: Disk & Block
- Example 14-7

- **$\Delta PE_B = \Delta KE_B + \Delta KE_A + Friction$**
- $W\ h = (½)mv^2 + (½)I\omega^2 + F\ h$

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Example 14-18

- **$\Delta PE_B = \Delta KE_B + \Delta KE_A + Spring\ Work$**

- $W\ h = (½)m(v_2^2 - v_1^2) + (½)I(\omega_2^2 - \omega_1^2) + (½)k(s_2^2 - s_1^2)$

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Conservation: Plane Motion

Combination of all types of energies

Determine which body loses PE
(which item loses elevation)

Equate Loss of PE to Change of all other energies

Don't forget ΔKE of dropping item

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Example 14-19

- First determine which item drops
- List all other changes in energy
- Cylinders will have both linear and angular changes in energy
- Determine whether friction is a factor (friction work)

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Example 14-20

- Example has both block B and Cylinder A losing PE
- Put both PE losses on one side of the equation

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Example 14-21

- Loss of PE in block B equals change in KE of block B, Friction Work of block B, and both angular and rectilinear KE of cylinder A

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Power and Efficiency

- Power = Work per unit of time
- P = U/t
- SI system: U is in joules (J)
- t is in seconds (s)
- P is in watts (W)
- 1 watt = 1 J/s = 1 N m/s

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Power in English Units

- P = U/t
- Where
  U = work (ft-lb)
  t = time (seconds)
  P = power (ft-lb/sec)

1 hp = 550 ft-lb/sec = 33,000 ft-lb/min

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Power

Power (in hp) = (F x s)/(550t)

Where

F = Force (pounds)

s = distance (feet)

t = time (seconds)

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Rotational Power

- Since U = Torque x θ and $\omega = \theta/t$
- And P = U/t
- Then Power = Torque x ω
- Conversion: 1 hp = 0.746 kW

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Examples

- 14-22: Power = Work/time
- 14-23: hp = Work/(550 x time)

  Or find power and convert to hp
- 14-24: hp equation = Fs/33000t
- 14-25: hp = (F x s)/550t

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Efficiency

- Efficiency (%) =
- (P output/)(P input) x 100%
- Always less than 100%

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Examples

- 14-26: Power Calculation only
- 14-27: Motor Efficiency
- 14-28: Power Calculation

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Week 13 Homework

- Chapter 14
  - Problems: 62, 68, 75, 78, 86, 96, 98 & 99
- Read Sections 15 - 1 and 15 - 2 for next week

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