

UNIT VII: WS 3b Quantitative Bar Graphs and Problems

For each situation shown below:

- In the energy flow diagram show the system you choose to analyze. Assume the systems to be frictionless unless stated otherwise.
- Complete the energy bar graph QUANTITATIVELY (numerically accurate).
- In the space below each diagram use conservation of energy equations to solve for the quantity called for in the question.

- A moving cart hits a spring, traveling at 5.0 m/s at the time of contact. At the instant the cart is motionless, by how much is the spring compressed?

$m = 8.0 \text{ kg}$
 $v = 5.0 \text{ m/s}$

$k = 50 \frac{\text{N}}{\text{m}}$
 $v = 0$

Initial

E_K E_g E_{el}

Energy Flow Diagram

Final

E_K E_g E_{el} E_d

- Determine final velocity of the cart, assuming that 10% of the energy is dissipated by friction.

$v = 0$

height (m)

5

$m = 20 \text{ kg}$

0

Initial

E_K E_g E_{el}

Energy Flow Diagram

Final

E_K E_g E_{el} E_d

- A block is placed on a spring, compressing it 0.30m. What height does the block reach when launched by the spring?

$k = 100 \frac{\text{N}}{\text{m}}$
 $\Delta x = 0.30 \text{ m}$

$m = 500 \text{ g}$
 $v = 0$

Initial

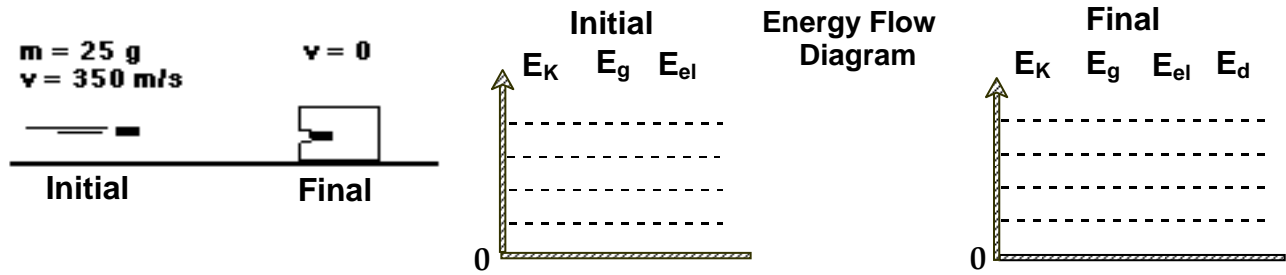
E_K E_g E_{el}

Energy Flow Diagram

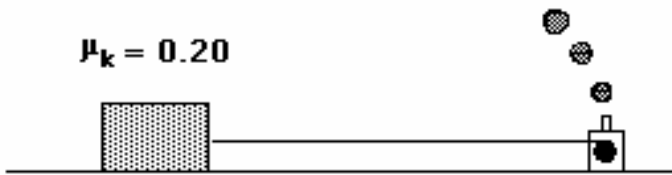
Final

E_K E_g E_{el} E_d

4. The bullet strikes a block of wood which exerts, on average, a force of 50,000N opposing the motion of the bullet. How far does the bullet penetrate?



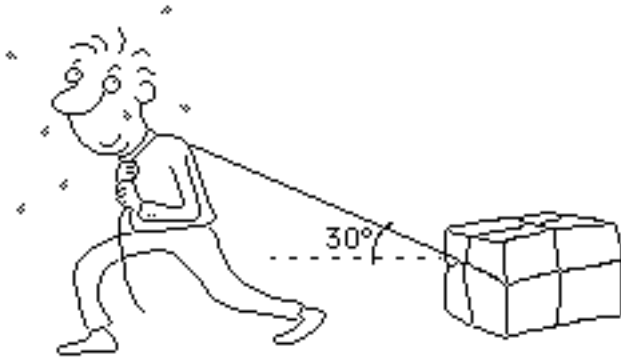
5. A 200. kg box is pulled at constant speed by the little engine pictured below. The box moves a distance of 2.5 m across a horizontal surface.



- Draw a force diagram of all relevant forces acting on the box.
 - Construct a qualitative energy bar graph/flow diagram for this situation. Be sure to specify your system.
 - How much energy is transferred by the engine?
 - What type of motion would occur if the engine pulled with a force of 500 N? Modify your force diagram and apply Newton's 2nd Law.
6. How far could the box in problem 5 be pulled *at constant velocity* with the expenditure of 8,000 J of energy?

7. A person pulls a 50 kg box pictured below with a force of 100. N. The coefficient of kinetic friction is 0.15.

a. Sketch a force diagram for the box.



- b. How much of the force acts in the direction of motion? How much energy is transferred (via working) by the person who pulls the box a distance of 10. m?

- c. Is the box moving at constant speed? Explain how you know. What does this tell you about the kinetic energy E_k of the system?

- d. How much energy is stored as internal energy due to friction in the pulling process? What eventually happens to this energy?

- e. Show that energy is conserved in the system, accounting for all the energy stored and transferred in the process.

