

SiQuENC for

*Work and energy*

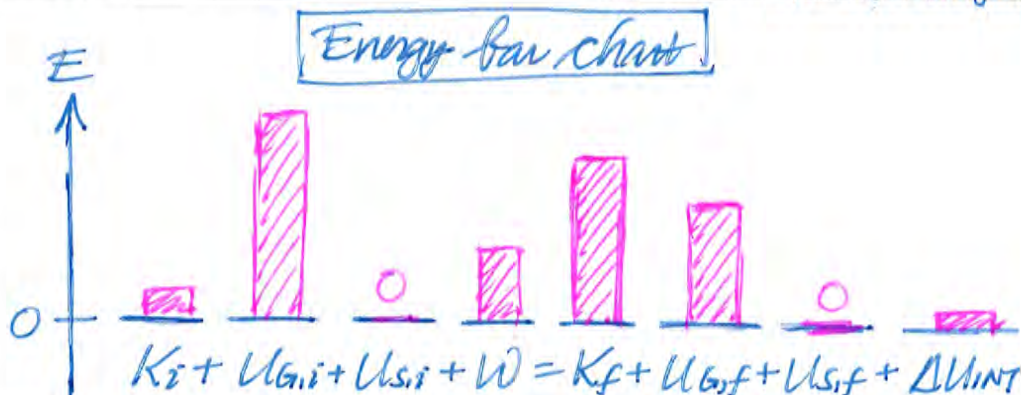
*E SiQuENC*

Neatly and graphically represent Situation(s)

1. **Read** a few words.
2. Make sure the meaning of those words is **illustrated** in your sketches/tables.
3. **Underline** the words.
4. **Repeat** with the next few words, if any.

- Draw **bubble** around system.
  - Draw **dot** for each "particle."
- Label:**
- At/Through: *t<sub>i</sub>, t<sub>f</sub>*
  - Axes: *+h (if a height changes)*

Graphically represent Quantities



Identify allowed Equation(s)

$$K_i + U_{G,i} + U_{S,i} + W = K_f + U_{G,f} + U_{S,f} + \Delta U_{INT}$$

ANalyze

Cross out quantities that are obviously 0.

$$W = 0? \quad \Delta U_{INT} = 0?$$

Substitute constitutive relationships.

$$K = \frac{1}{2} m v^2 \quad U_G = m g h \quad U_S = \frac{1}{2} k (l - l_0)^2$$

$$\text{Signed area between } F_{ii} - l \text{ plot and } l \text{ axis} = W_F$$

Perform algebraic and proportional reasoning.

Communicate

"The system is the ...."

Recipe

"By [relationship], the [quantity] [prepositional phrase] ... equals [or is proportional to] ..."

*By the definition of kinetic energy, the kinetic energy of the block is proportional to the square of the block's speed when ...*

"The ... is 0, so, by [relationship], the [adjective] [quantity] [prepositional phrase] ... [verb] ..."

*The work on the system and change in internal energy are 0, so by the generalized work-energy principle, the initial ...*

"... the [total quantity] ([quantity 1] [prepositional phrase 1] [plus] ...) ..."

*... the total initial kinetic energy (initial kinetic energy of the cart plus initial kinetic energy of the block) ...*

Equal

"The ... stays the same."

Altered

"The ... [increases/decreases] ...."

So what?

"So the ... must ...."

Next?

(Check whether you've addressed all directives).

## SiQuENC for Work and energy

The letters S and i stand for Situations: Neatly and graphically represent **S**ituation(s)

1. **Read** a few words.
2. Make sure the meaning of those words is **illustrated** in your sketches/tables.
3. **Underline** the words.
4. **Repeat** with the next few words, if any.
  - Draw **bubble** around system.
  - Draw **dot** for each "particle."

**Label:**

- At/Through: t-sub-i, t-sub-f
- Axes: +h (if a height changes)

The letters Q and u stand for Quantities: Graphically represent **Q**uantities

Energy bar chart

Plot E on the vertical axis. Draw a tickmark labeled 0. At the height of this tickmark, draw eight horizontal segments to the right, spaced apart so that each horizontal segment is labeled underneath by one of the terms of the equation  $K_{-sub-i} + U_{-sub-G,i} + U_{-sub-S,i} + W = K_{-sub-f} + U_{-sub-G,f} + U_{-sub-S,f} + \Delta U_{-sub-INT}$ . Fill in a concrete example bar chart. Adjust the heights of bars in your bar chart, if needed, to make sure that the sum of the graphically represented values of the first four terms of the labeling equation equals the sum of the graphically represented values of the last four terms of the labeling equation.

E stands for Equation(s): Identify allowed **E**quation(s)

$$K_{-sub-i} + U_{-sub-G,i} + U_{-sub-S,i} + W = K_{-sub-f} + U_{-sub-G,f} + U_{-sub-S,f} + \Delta U_{-sub-INT}$$

N is the second letter of "**A**Nalyze".

Cross out quantities that are obviously 0.

$$W = 0? \Delta U_{-sub-INT} = 0?$$

Substitute constitutive relationships.

$$K = \text{one-half } m_{-sub-l} \text{ times the square of } v$$

$$U_{-sub-G} = m_{-sub-G} \text{ times } g \text{ times } h$$

$$U_{-sub-S} = \text{one-half } k \text{ times the square of the difference cursive-l minus cursive-l-naught}$$

$$\text{Signed area between F-sub-parallel-cursive-l plot and cursive-l axis} = W_{-sub-F}$$

Perform algebraic and proportional reasoning.

C stands for **C**ommunicate.

Phrasal template: "The system is the dot-dot-dot"

REASoN is spelled R, E, A, So, and N.

R stands for **R**ecipe.

Phrasal template: "By [relationship], the [quantity] [prepositional phrase] ... equals [or is proportional to] ..."

Example phrase: By the definition of kinetic energy, the kinetic energy of the block is proportional to the square of the block's speed when dot-dot-dot

Phrasal template: "The ... is 0, so, by [relationship], the [adjective] [quantity] [prepositional phrase] ... [verb] ...."

Example phrase: The work on the system and change in internal energy are 0, so by the generalized work-energy principle, the initial dot-dot-dot

Phrasal template: "... the [total quantity] ([quantity 1] [prepositional phrase 1] [plus] ...) ..."

Example phrase: dot-dot-dot the total initial kinetic energy (initial kinetic energy of the cart plus initial kinetic energy of the block dot-dot-dot) dot-dot-dot

E stands for **E**qual

Phrasal template: The blank stays the same.

A stands for **A**ltered.

Phrasal template: The blank [increases/decreases] dot-dot-dot.

The So stands for **S**o what?

Phrasal template: So the blank must blank.

N stands for **N**ext?

(Check whether you've addressed all directives).