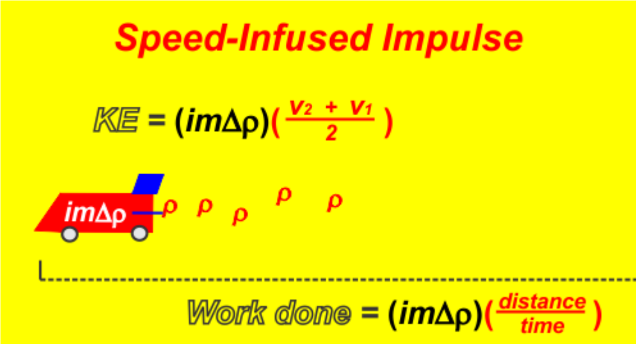
Six Duality Laws of
Momentum and Energy

Guide for improving standards.



2. Second Duality Law of Perceived Speedy-Impulse

Du-Ane Du

www.Wacky1301SCI.com, *"Looking at serious science, sideways!"*

Mathematical Duality Law #2: In lay terms, impulse ($im\Delta\rho = Ft$) can be thought of as the amount of effort used to accomplish a task, as measured in terms of average force and time. Energy-work then, is a (*) joint perception of average speed and impulse, speed-infused effort, or speedy impulse.

$$energy = (speed)(effort) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = (distance/time)(im\Delta\rho) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = (d/t)(Ft) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = \left(\frac{v_2+v_1}{2}\right)(im\Delta\rho) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2 = \text{"}speedy\text{-}im\Delta\rho\text{"}$$

* (reward oriented, psychological)

This is the second of a series of six advanced articles on the duality laws for momentum and mechanical energy. This article will use lay language to examine the history and origin of the momentum-energy duality, and will make recommendations on how scientists can better notate the nature of the momentum-energy duality when recording experimental data, etc. (Less complex discussions of these topics can also be found at www.Wacky1301SCI.com)

Devil's Advocate says, "Allow this essay to stretch your imagination—like you were on an African safari: Exciting new birds in the trees, the joy of taking dazzling pictures—discovering a vision of things you'd never imagined before. Let's explore a new vision of the world around us…"

Employer's need for speedy impulse

Symbols
$im\Delta\rho$ = impulse
10 ρ = 10 kgm/s
10 ρ = 10 N*s

While the origin of the work-energy philosophy is not known, a plausible scenario can be developed by looking back tens of thousands of years, when one of history's first employers negotiated with workers to construct a wall by moving rocks from the quarry to the site of the wall, a distance of 1000 steps.

Ages ago, distance was a measurable unit, force/weight was a measurable unit, the number of trips could be counted, but time was difficult to measure accurately. The most common method of measuring time was the movement of shadows along the ground—and time was probably only measured to the nearest quarter hour.

During contract negotiations, the worker's primary concern would have involved financial compensation for the effort needed to lift the rocks and carry them from the quarry to the wall. This effort would result in muscle fatigue and hunger.

The muscle fatigue is the result of the weight of the rocks as well as the amount of time that the rocks are carried. Carrying 1 rock for 3 hours would result in 3 rock-hours of muscle fatigue. Similarly, carrying 3 rocks for 1 hour would also result in 3 rock-hours of muscle fatigue.

Muscular effort, then could be calculated using the equation:

$$effort = (weight\ of\ rocks)(time)$$

Weight is a type of force, so this equation for effort is roughly equivalent to:

$$effort = (force)(time)$$

"Interesting," Devil's Advocate says, "This lay concept of muscular effort is synonymous with the scientific concept of impulse, where:"

$$impulse = im\Delta\rho = Ft = effort$$

Correct, but while the workers focused their part of the negotiations on the muscular effort ($im\Delta\rho$) used to complete the task, the employer had a significantly different perspective.

When the employer saw a worker walking slowly, the employer perceived lazy low-energy work. In contrast, when the employer saw a worker moving quickly, the employer perceived enthusiastic high-energy work. The employer realized that speed saved time, impulse, and money.

The employer could not deny the existence of muscular effort and the need to pay the workers for the amount of impulse used. Likewise, the workers recognized that speed also needed to be included in the calculation.

The win-win solution was to create the concept of speed-infused effort, or speedy impulse, and pay the workers for the product of the speed and the effort:

$$speedy\text{-}im\Delta\rho = (speed)(effort)$$
$$speedy\text{-}im\Delta\rho = (\frac{distance}{time})(im\Delta\rho)$$
$$speedy\text{-}im\Delta\rho = (\frac{distance}{\boldsymbol{time}})(force \times \boldsymbol{time})$$
$$speedy\text{-}im\Delta\rho = (force \times distance)(\frac{\boldsymbol{time}}{\boldsymbol{time}})$$
$$speedy\text{-}im\Delta\rho = force \times distance$$
$$\boldsymbol{speedy\text{-}im\Delta\rho = Fd = Work\text{-}done}$$

Notice that the time component has canceled out. The exact time is now irrelevant, the exact effort/impulse is irrelevant, and the actual speeds are irrelevant. All the employer needs to do is measure the weight of the rocks, multiply by the distance, and pay the workers accordingly.

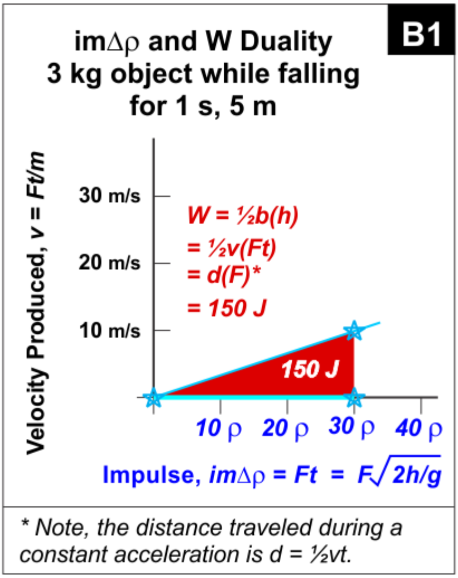
From the worker's perspective, one of history's best motivators has been born: "When the work is done, collect your money and go—the sooner you finish, the sooner you get paid!"

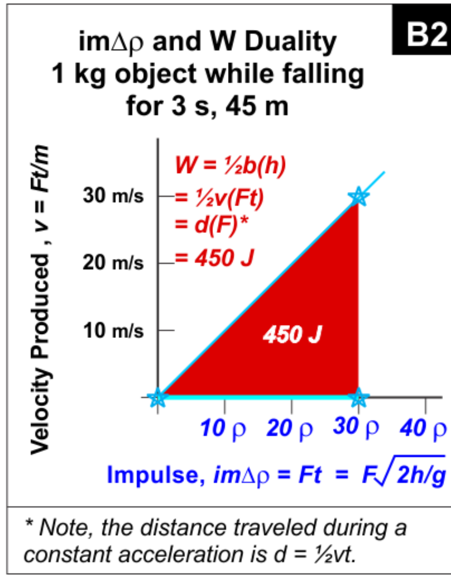
"Great invention," Devil's Advocate says, "the key to this win-win solution is the perception of work-energy as speedy effort, or speedy impulse:"

$$speedy\text{-}im\Delta\rho = \left(\frac{distance}{time}\right)(im\Delta\rho)$$

The W-Speedy-ImΔρ of Work-Energy

Work-done by employees, then, is a form of speedy impulse. This conclusion connects directly to the work-energy "produced" when object's fall, as seen in these graphs taken from Article 1, Illustration B:





"Earlier, in the story," Devil's Advocate says, "the worker's muscles produced an impulse when they lifted the rocks for a given amount of time."

And, in the case of gravity pulling down on an object, the impulse is being produced by the earth, and it is being received by the object's mass. (See *Murdered Energy Mysteries*, Chapter 201.)

The earth gives all objects approximately 10 *ρ* of momentum every second, for each kilogram of mass in the object. This corresponds to the gravitational acceleration of 10 m/s, or 10 *ρ*/s/kg.

For example, if a 3 kg object falls for 1 s, it will experience an impulse of:

$$\text{B1}, im\Delta\rho = (3\ kg)(1\ s)(10\frac{\rho/s}{kg})$$
$$\text{B1}, im\Delta\rho = 30\ \rho$$

Similarly, if a 1 kg object falls for 3 s, it will experience an impulse of:

$$\text{B2}, im\Delta\rho = (1\ kg)(3\ s)(10\frac{\rho/s}{kg})$$
$$\text{B2}, im\Delta\rho = 30\ \rho$$

Clearly, the earth is producing a gravitational form of impulse, the impulse is increasing the object's momentum, the increasing momentum is causing a visible increase in the object's velocity.

According to the two graphs, the W-speedy-imΔρ can be calculated by multiplying the "speedy" average velocity ($\frac{v_2 + v_1}{2}$, or Y-axis) by the impulse (X-axis), producing:

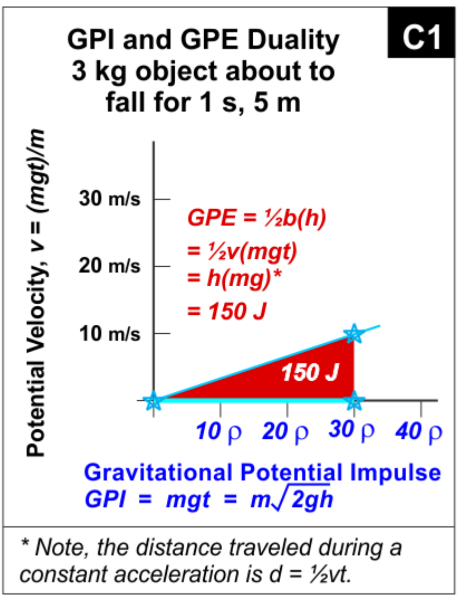
$$\text{B1}, W\text{-}speedy\text{-}im\Delta\rho = 150\ J = Work\ Energy$$
$$\text{B2}, W\text{-}speedy\text{-}im\Delta\rho = 450\ J = Work\ Energy$$

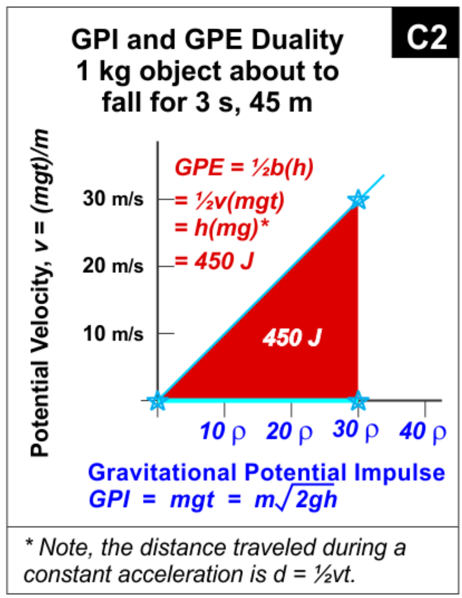
And so, by merging the perception of average speed with the perception of impulse, we produce a joint perception of energy as speed-infused impulse, or speedy impulse. In this way, we perceive the earth as performing 150 $J_{[0.20]}$ of work on the 3 kg object, and 450 $J_{[0.067]}$ of work on the 1 kg object.

"Work-energy then," Devil's Advocate says, "is a (*) joint perception of average speed produced ($\frac{v_2 + v_1}{2}$) fused with impulse used, speed-infused effort, or speedy impulse. *(reward oriented, psychological)"

The GPE-Speedy-ImΔρ of Gravitational Energy

There is also a connection between potential speedy-impulse and gravitational potential energy. Consider the graphs of GPI and GPE used in Article 1, Illustration C:





Notice, the Y-axis is displaying the potential "speedy", and the X-axis is displaying the potential impulse. As before, the GPE-speedy-*im*Δρ can calculated by multiplying the "speedy" average velocity ($\frac{v_2 + v_1}{2}$, Y-axis) by the impulse (X-axis), producing:

$$\text{C1}, GPE\text{-}speedy\text{-}im\Delta\rho = 150\ J = Grav.Po.Energy$$

$$C2, GPE\text{-}speedy\text{-}im\Delta\rho = 450\,J = Grav.Po.Energy$$

The reality of GPE as speedy impulse can be illustrated by deriving the GPE equation from the original speedy-impulse equation:

$$speedy\text{-}im\Delta\rho = (\frac{distance}{time})(im\Delta\rho)$$
$$speedy\text{-}im\Delta\rho = (\frac{d}{t})(Ft)$$
$$speedy\text{-}im\Delta\rho = (\frac{h}{t})(mgt)$$
$$\boldsymbol{speedy\text{-}im\Delta\rho = mgh = Grav.Potential\ Energy}$$

"Interesting," Devil's Advocate says, "you can see that the speedy-impulse equation and the GPE equation are mathematically equivalent. This means, Gravitational Potential Energy-work is a (*) joint perception of potential average speed $(\frac{v_2 + v_1}{2})$ fused with potential impulse, or speed-infused effort, or speedy impulse. *(reward oriented, psychological)"

The KE-Speedy-Im$\Delta\rho$ of Kinetic Energy

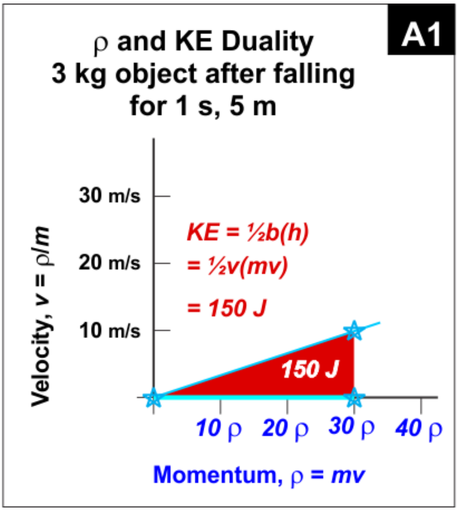
The connection between speedy impulse and kinetic energy can be seen in the derivation:

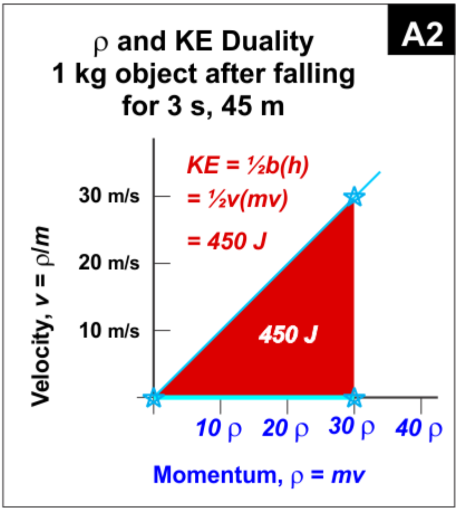
$$speedy\text{-}im\Delta\rho = (im\Delta\rho)(\frac{distance}{time})$$
$$speedy\text{-}im\Delta\rho = (mv_2 - mv_1)(average\ speed)$$
$$speedy\text{-}im\Delta\rho = m(v_2 - v_1)(\frac{v_2 + v_1}{2})$$
$$speedy\text{-}im\Delta\rho = \frac{1}{2}m(v_2 - v_1)(v_2 + v_1)$$
$$speedy\text{-}im\Delta\rho = \frac{1}{2}m(v_2^2 - v_1^2)$$

$$speedy\text{-}im\Delta\rho = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 = kinetic\ energy$$

"Once again," Devil's Advocate says, "the kinetic energy equation is a variant of the speedy-impulse equation."

Excellent conclusion, now consider the graphs of momentum and kinetic energy used in Article 1, Illustration A:





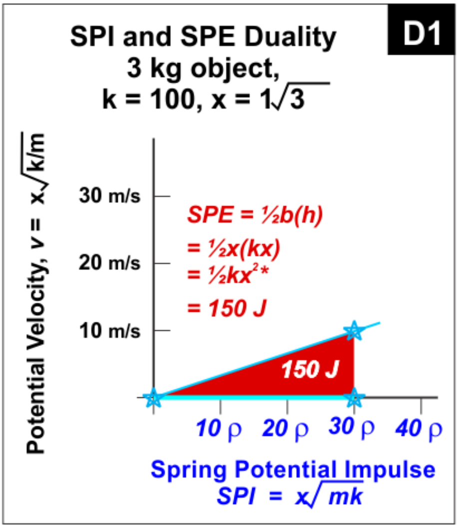
The Y-axis displays the "speedy", and the X-axis displays the momentum produced. The KE-speedy-*im*$\Delta\rho$ is calculated by multiplying the "speedy" average velocity ($\frac{v_2 + v_1}{2}$, or Y-axis) by the momentum (X-axis), producing:

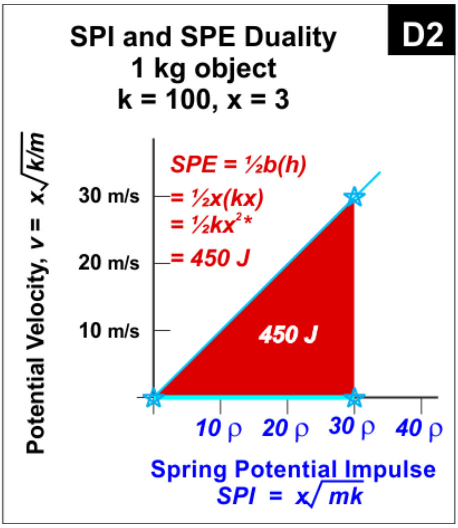
$$A1, KE\text{-}speedy\text{-}im\Delta\rho = 150\ J = Kinetic\ Energy$$
$$A2, KE\text{-}speedy\text{-}im\Delta\rho = 450\ J = Kinetic\ Energy$$

Kinetic energy then, is the (*) joint perception of average speed produced ($\frac{v_2 + v_1}{2}$) fused with momentum-increase, speed-infused momentum-transfer, or speedy impulse. *(reward oriented, psychological)

The SPE-Speedy-ImΔρ of Spring Potential Energy

Rather than spend too much time on the obvious, consider the SPI, SPE graph used in Article 1, Illustration D:

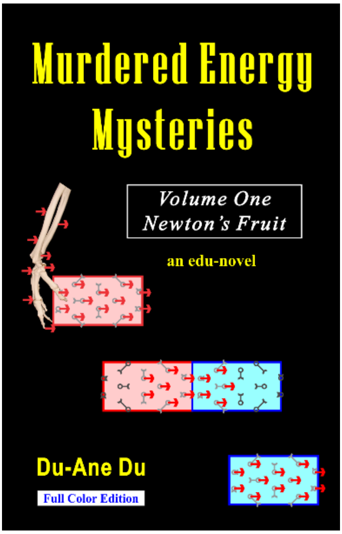




Note the Y-axis is displaying the potential "speedy", and the X-axis is displaying the spring potential impulse. As before, the SPE-speedy-*im*Δρ can be calculated by multiplying the "speedy" average velocity ($\frac{v_2 + v_1}{2}$, or Y-axis) by the impulse (X-axis), producing:

$$\text{D1}, SPE\text{-}speedy\text{-}im\Delta\rho = 150\,J = Spring\ P.Energy$$
$$\text{D2}, SPE\text{-}speedy\text{-}im\Delta\rho = 450\,J = Spring\ P.Energy$$

Spring Potential Energy-work then, is the (reward oriented, psychological) joint perception of potential average speed $(\frac{v_2 + v_1}{2})$ fused with potential impulse, or speed-infused potential impulse, or speedy impulse.



[Examine or purchase at Amazon.com]

"In fact," Devil's Advocate says, "since all forms of energy can be expressed as mechanical energy, energy in all its forms is actually the human perception of speedy impulse and speedy momentum-increase."

Excellent point, this perception is actually a cycle of perceptions, which can be expressed as:

$$GPE\text{-}speedy\text{-}im\Delta\rho = Grav.\,Potential\ Energy$$
$$WE\text{-}speedy\text{-}im\Delta\rho = Work\ Energy$$
$$KE\text{-}speedy\text{-}im\Delta\rho = Kinetic\ Energy$$
$$SPE\text{-}speedy\text{-}im\Delta\rho = Spring\ Potential\ Energy$$

Noting the Impulse Coefficient

Because energy is the perception of speedy impulse, it is wise to adjust energy notation to reflect the Impulse Coefficient [IC] involved. The Impulse Coefficient identifies the average impulse content involved in the given measurements. The most direct equation for the Impulse Coefficient is:

$$[IC]\ \textit{Impulse Coefficient} = \frac{im\Delta\rho}{energy} = \frac{\rho}{J}$$

In future articles, we will discover that the impulse coefficient has a direct bearing on the joules unit, therefore it should be attached as a logarithm-like base, such as:

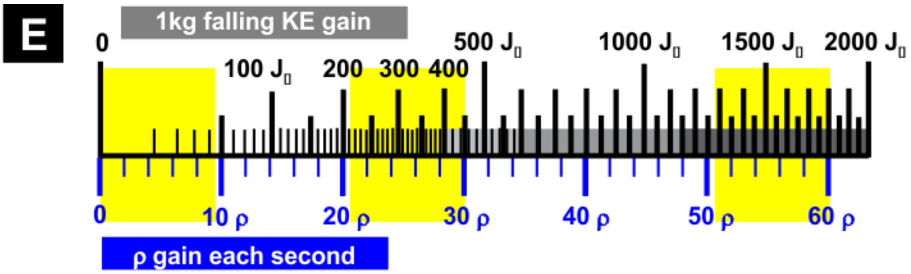
$J_{[IC]}$ *means each joule contains* $[IC]\rho$ *of* $im\Delta\rho$

$100\ J_{[0.45]}$ *means each joule involves* $0.45\ \rho$ *of* $im\Delta\rho$

$100\ J_{[0.050]}$ *means each joule involves* $0.05\ \rho$ *of* $im\Delta\rho$

$100\ J_{[0.0008]}$ *means each joule involves* $0.0008\ \rho$ *of* $im\Delta\rho$

The role of the impulse coefficient can be visualized by examining a line graph of the momentum gain and energy gain of a falling object. This first graph is of a 1 kg ball falling for 6 seconds:



The bottom of the graph lists the momentum of the falling 1 kg ball. Each second it experiences 10 ρ of impulse and gains 10 ρ of momentum.

The top of the graph shows the kinetic energy values. Notice that the ticks are very wide at the beginning, and become narrower as the ball accelerates (to the right).

The left yellow box highlights the first second of fall, when the momentum is increasing from 0 ρ to 10 ρ. The average joule tick-size during the first second is:

$$average\ tick\ size, 1^{st}\ sec = \frac{\rho_2 - \rho_1}{J_2 - J_1} = \frac{10\rho - 0\rho}{50J - 0J} = 0.2\,\frac{\rho}{J}$$

The impulse coefficient for the first second is calculated using the same equation as the average joule tick-size. Therefore, the impulse coefficient and the joule production rate during the first second are:

$$[IC]\ 1^{st}\ second = \frac{im\Delta\rho}{energy} = \frac{10\rho - 0\rho}{50J - 0J} = [0.20\,\frac{\rho}{J}]$$

$$\boldsymbol{energy\ gain\ (speedy\text{-}im\Delta\rho) = 50\,J_{[0.20]}}$$

** Note, the impulse coefficient of $J_{[0.20]}$ means the average joule is size [0.20], it involves 0.2 ρ of impulse and a speedy multiplier of 5 m/s.*

Connecting to the earlier concept of energy as speedy impulse, or energy = (average speedy)(impulse), the speed multiplier and joule productivity rate that amplifies the impulse will always be:

$$speedy\ multiplier = \frac{1}{[IC]} = \_\_\_\_\frac{m}{s}$$

$$above\ speedy\ multiplier = \frac{1}{[IC]} = \frac{1}{[0.20]} = 5\,\frac{m}{s}$$

$$joule\ productivity\ rate = \frac{1}{[IC]} = \frac{1}{[0.20\ \rho/\mathrm{J}]} = 5\,\frac{J}{\rho}$$

The second yellow box highlights what is happening during the 3rd second of fall. Using the same equations, the average joule tick-size, impulse coefficient, and joules generated during the 3rd second are:

$$average\ tick\ size, 3^{rd}\ sec = \frac{\rho_2 - \rho_1}{J_2 - J_1} = \frac{30\rho - 20\rho}{450J - 200J} = 0.04\frac{\rho}{J}$$

$$[IC]\ 3^{rd}\ second = \frac{im\Delta\rho}{energy} = \frac{30\rho - 20\rho}{450J - 200J} = [0.04\frac{\rho}{J}]$$

$$\boldsymbol{energy\ gain\ (speedy\text{-}im\Delta\rho) = 250\ J_{[0.04]}}$$

** Note, the impulse coefficient of $J_{[0.04]}$ means the average joule is size [0.04], it involves 0.04 ρ of impulse, a speedy multiplier of $\frac{1}{[0.04]}$ = 25 m/s, and a joule productivity rate of $\frac{1}{[0.04\ \rho/J]}$ = 25 J/ρ.*

Finally, the third yellow box highlights the 6th second of fall. The average joule tick-size, impulse coefficient, and joules generated during the 6th second are:

$$avg.tick\ size, 6^{th}\ sec = \frac{\rho_2 - \rho_1}{J_2 - J_1} = \frac{60\rho - 50\rho}{1800J - 1250J} = 0.018\frac{\rho}{J}$$

$$[IC]\ 6^{th}\ sec = \frac{im\Delta\rho}{energy} = \frac{60\rho - 50\rho}{1800J - 1250J} = [0.018\frac{\rho}{J}]$$

$$\boldsymbol{energy\ gain\ (speedy\text{-}im\Delta\rho) = 550\ J_{[0.018]}}$$

** Note, the impulse coefficient of $J_{[0.018]}$ means the average joule is size [0.018], it involves 0.018 ρ of impulse and a speedy multiplier of $\frac{1}{[0.018]}$ = 55.6 m/s, and a joule productivity rate of $\frac{1}{[0.018\ \rho/J]}$ = 55.6 J/ρ.*

"Intriguing," Devil's Advocate says, "the graph and calculations make it obvious that accelerating forms of mechanical energy involve joules that vary in size."

Yes! And part of the purpose of the impulse coefficient is to help scientists track the average tick-width that is occurring in the measurements. The impulse coefficient also shows the amount of impulse contained in the average joule, and the impulse coefficient makes it easy to convert from joules to ρ of impulse/momentum.

It is important to understand that not all energy measurements involve accelerations, and not all measurements are multi-parabolic in nature. For more about joule size, see Article 3, "Third Duality Law of non-Standard Energy Sizes and Varying Productivity."

"Thus far," Devil's Advocate says, "the impulse coefficient has been found using impulse divided by energy."

There are other methods. Additional equations can be found by examining the units involved:

$$[IC] = \frac{im\Delta\rho}{energy} = \frac{kg \times \frac{m}{s}}{kg \times \frac{m}{s} \times \frac{m}{s}} = \frac{1}{m/s} = \frac{\mathbf{1}}{\boldsymbol{average\ speed}}$$

The mathematical definition of average speed can be adjusted and substituted into the equation to give another method of finding the impulse coefficient when a constant acceleration is present:

$$average\ speed = \frac{v_2 + v_1}{2}$$

$$\frac{1}{average\ speed} = \frac{2}{v_2 + v_1}$$

$$[IC]\ impulse\ coefficient = \frac{2}{v_2 + v_1} = \frac{time}{distance}$$

“This means,” Devil’s Advocate says, “the impulse coefficient is the inverse of the average speed. That’s very useful.”

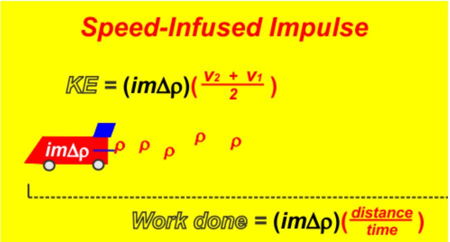
Very practical in itself. And with a little manipulation, we can develop specialized equations for the impulse coefficient associated with GPE and SPE. Depending on the situation, any of the following will work:

$$GPE[IC]\ impulse\ coefficient = \frac{GPI}{GPE}$$

$$GPE[IC]\ impulse\ coefficient = \frac{m\sqrt{2gh}}{mgh} = \sqrt{\frac{2}{gh}}$$

$$\boldsymbol{GPE[IC]\ impulse\ coefficient = \frac{mgt}{\frac{1}{2}mg^2t^2} = \frac{2}{gt}}$$

$$\boldsymbol{SPE[IC]\ impulse\ coefficient = \frac{x\sqrt{mk}}{\frac{1}{2}kx^2} = \frac{2\sqrt{m}}{x\sqrt{k}} = \sqrt{\frac{4m}{kx^2}}}$$



CONCLUSION 1: **Second Duality Law of Perceived Speedy-Impulse:** In lay terms, impulse ($im\Delta\rho = Ft$) can be thought of as the amount of effort used to accomplish a task, as measured in terms of average force and time. Energy-work

then, is a (reward oriented, psychological) joint perception of average speed and impulse, speed-infused effort, or speedy impulse.

$$energy = (speed)(effort) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = \left(\frac{distance}{time}\right)(im\Delta\rho) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = \left(\frac{d}{t}\right)(Ft) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = (F)(d) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = (mg)(h) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = (\frac{v_2+v_1}{2})(im\Delta\rho) = \text{"}speedy\text{-}im\Delta\rho\text{"}$$
$$energy = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2 = \text{"}speedy\text{-}im\Delta\rho\text{"}$$

CONCLUSION 2: Because energy is the perception of speedy impulse, the notation of energy-work is clearest when it includes the impulse coefficient involved. Some energy measurements are standard linearized, some are multi-linear, and some are multi-parabolic. Therefore, the clearest method of identifying the type of energy involved is to notate the impulse coefficient as a base to the joules unit:

$KE = 450\ J_{[0.067]}$ *means the average joule is size [0.067], and it involves 0.067 ρ of impulse, a speedy multiplier of* $\frac{1}{[0.067]}$ *= 15 m/s, and a joule productivity rate of* $\frac{1}{[0.067\ \rho/J]}$ *= 15 J/ρ.*

$$[IC] = \frac{impulse}{energy}$$
$$[IC] = \frac{2}{v_2 + v_1} = \frac{time}{distance}$$

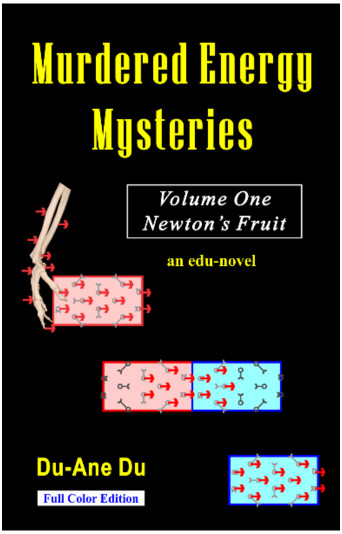
$$GP[IC] = \sqrt{\frac{2}{gh}}\ or\ \frac{2}{gt}$$

$$SP[IC] = \sqrt{\frac{4m}{kx^2}}$$

CONCLUSION 3: More research needs to be done into the relationship between mechanical energy and other theoretical forms of energy. Many common beliefs may actually be philosophical myths.

Murdered Energy Mysteries is an edu-novel that seeks to increase understanding of the various forms of momentum and momentum transfer, as well as the various forms of energy and energy transfer. The lack of understanding on the part of the scientific community is substantial, and more research needs to be done.

—Du-Ane Du, author of the edu-novel *Murdered Energy Mysteries* (Amazon, Kindle, e-book 2018, paperback 2021.)



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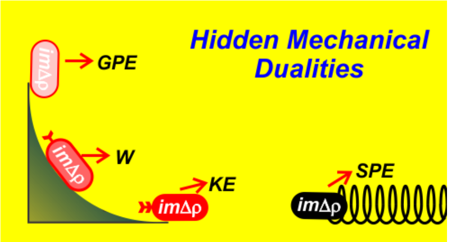
For more information, see:

Murdered Energy Mysteries, as well as:

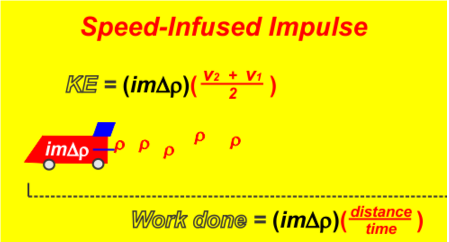
Six Duality Laws of Momentum and Energy

Guide for improving standards.

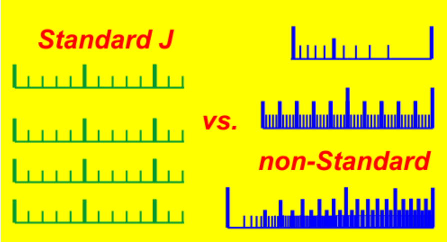
Article 1: First Duality Law of Momentum-Energy Coexistence



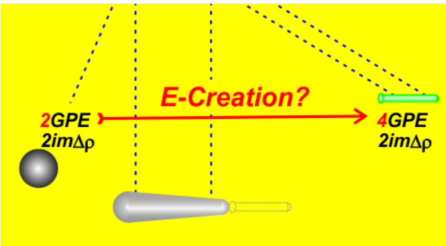
Article 2: Second Duality Law of Perceived Speedy-Impulse



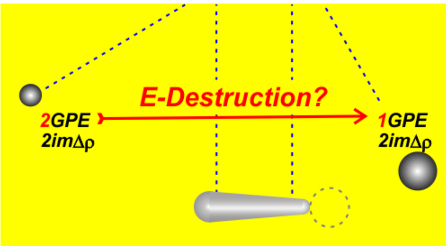
Article 3: Third Duality Law of non-Standard Energy Sizes and Varying Productivity



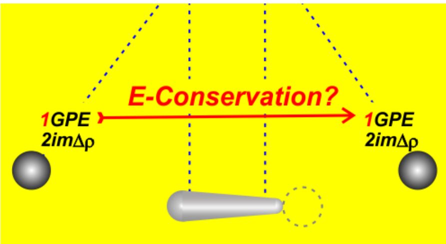
Article 4: Fourth Duality Law of Situational Energy Creation



Article 5: Fifth Duality Law of Situational Energy Destruction



Article 6: Sixth Duality Law of Situational Energy Conservation & Einstein



These advanced articles and less complex discussions of these topics are available at: www.Wacky1301SCI.com