The Space-sci Sherlocks Deduce

Work-Energy done on rocket by Chemical Potential Energy in black powder (From stationary start.)			**L**
	CPE in fuel	Work (*mad*) done on rocket	**Work eff.**
1	188 882 J[1.2]	$(0.2kg)\left(-375\frac{m}{s^2}\right)(-120m) = 9\,000J_{[0.006\,67]}$	**4.76%**
2	188 882 J[1.2]	$(1kg)\left(75\frac{m}{s^2}\right)(24m) = 1\,800J_{[0.033]}$	**0.95%**
3	188 882 J[1.2]	$(3kg)\left(-25\frac{m}{s^2}\right)(-8m) = 600J_{[0.10]}$	**0.32%**
4	188 882 J[1.2]	$(0.04kg)\left(1875\frac{m}{s^2}\right)(600m) = 45\,000J_{[0.0040]}$	**23.8%**

Does Chemical Energy Create Kinetic or Work Energy?

Professor Du-Ane Du

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

> Three sisters, Pico, Hectii, and Tera, the “Space-sci Sherlocks,” are traveling through the Asteroid Belt. They stop to explore an asteroid and perform these motion experiments.
> —Excerpted from *Murdered Energy Mysteries*, Part 2, Chapter 1, by Du-Ane Du, (Amazon, Kindle, ebook 2018, paperback 2021).

“As we ended the call, I heard Pico singing:”

Take the impulse, Times the speedy,

t' Find the speedy impul -l -l -l -l -l -lse,
'Cause that's what energy is—!

"Very inventive, the girls are," Chip Micro said.

"Yes, I can still hear her singing in my mind," Grandpa Prog said with a laugh. "You know, their questions reminded me of the *energia*/energy paradox that my brother Kief and I encountered over 60 years ago—I believe I was in high school at the time. The *energia*/energy paradox turned out to be an important discovery."

Proge took a long sip of iced tea. "Record this anecdote, Chip. We'll add it to my memoirs."

"Recording, Sir," Chip said after activating his voice-to-text conversion software.

Proge closed his eyes and began reciting his story:

> Our first encounter with the *energia*/energy paradox happened during a vacation at the moon's Tranquility Colony.

“I’m bored, Proge,” my older brother Kief said one day. “Let’s build a toy rocket and do some experiments with it.”

“Do we have access to any good fuels?” I said. “There’s no atmosphere here on the moon. The fuel must have its own oxygen source, or it won’t burn.”

“Black powder can burn in the vacuum of space,” Kief said.

“I bet we can pick up some black-powder toy rockets at the store, and plenty of extra fuel cartridges,” I said.

“If we want to do experiments, let’s see if they have a bomb calorimeter too,” Kief said.

“Awesome idea,” I said. “We can use the bomb calorimeter to find out how much chemical/heat-*energia* is stored in the black powder.”

“Exactly,” Kief said. “Then we can launch the rocket in a variety of situations and test how efficient the engine is.”

“Should we check the efficiency with respect to chemical/kinetic energy?” I said. “Or maybe with respect to momentum?”

“Why momentum? Scientists always use energy when checking efficiency.”

“True,” I said. “But as long as we’re finding the change in velocity, we may as well calculate the change in momentum, too.”

"And use the change in momentum to find the momentum efficiency," Kief said. "Sure, Proge, why not?"

"We have almost a week to kill before the next transport leaves for Mars."

"It'll be nice to be back at Mars Colony."

I nodded, "Even if it does mean school is about to start."

We did some initial tests with the bomb calorimeter. Skipping the boring details, we found that exploding 66 g of black powder added 188 882 J[1.2] of heat *energia* to the water in the calorimeter. I believe that corresponds to the accepted values for black powder.

"It does, Professor," Chip said. "Please continue with your story."

In the Hex-C11 model rocket engine, the 66 g of black powder produced a thrust of 75 N for 0.80 s.

"Everything checks out normal," Kief said, as he keyed the data into his phone:

Fuel & Engine Data	**A**
Hex-C11 rocket engine	Fuel: 66.0 g black powder
Average force: 75 newtons	Burn time: 0.80 seconds
Black powder chemical heat *energia* (CPE): 188 882 joules[1.2]	

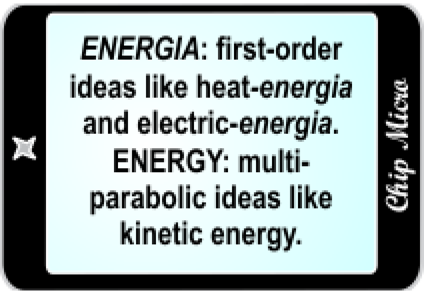
"Now I want to calculate the amount of impulse that's chemically stored in the fuel," I said.

> “So you can test the rockets for momentum efficiency?”
>
> “Worth a try, you never know what you’ll discover when you do a traditional experiment in an unusual manner,” I said. “Before we burned the black powder in the calorimeter, the calorimeter had 1.0 kg of water at room temperature.”
>
> “The molecules of water are always in motion, and many scientists believe that the temperature of the water is determined by the amount of kinetic energy in the water molecules,” Kief said.

“Pardon my interruption, Professor,” Chip said. “Did Kief use the term heat *energia*, or heat *energy*?”

“Good question,” Proge articulated approvingly. “Normally I prefer using the term *energia* for standard linearized mathematical behaviors like standard linearized H&E [heat & electric] joules[1.2], and I prefer to use the term *energy* for multi-parabolic kinetic-joules[IC] and multi-linear work-joules[IC].”

“The terms *energia* and *energy* both come from the Greek word *energeia*, which was first used by Aristotle,” Chip said. “Aristotle also established the philosophical foundations for ideas such as force, impetus, and work, as well as the elements, earth, water, wind, and fire.”


ENERGIA: first-order ideas like heat-*energia* and electric-*energia*. ENERGY: multi-parabolic ideas like kinetic energy.

“Precisely, the concept of *energeia* was an important part of Aristotelian philosophy for thousands of years,” Proge said, a professorial tone entering his voice. “Then in the late 1600’s, the historian/philosopher Gottfried Leibniz and some other Newtonian scientists connected Aristotle’s idea of *energeia* to three different math equations.

“Leibniz proposed that perfect *vis-visa*, or natural energy, could be identified by the multi-parabolic equation $NE = mv^2$. Moving *vis-visa*, or kinetic energy was eventually identified with the multi-parabolic equation, $KE = \frac{1}{2}mv^2$. And stored *vis-visa*, or potential energy was eventually identified with the multi-parabolic equation $PE = mad$. Leibniz used different names for these equations, but the meaning is the same.”

“Does this relate to your story?” Chip said.

“Actually it does, the juxtaposition of standard linearized *energia* and multi-parabolic energy creates a paradox that is the essence of this anecdote,” Proge said with a touch of pride.

"Speaking of multi-parabolic mathematics," Chip said. "Shall I record this anecdote using modern mathematical notation or historical notation?"

"Good point," Proge said, focusing on a beautiful orange and pink plumeria blossom that was waving in the breeze. "The Educational Reform Act of 2081 discourages the use of old mathematical notation even in historical stories. Let's compromise, use first-order equal signs at all times, but include the impulse coefficient [IC] on all multi-parabolic concepts. We'll explain the technical differences later."

"As you wish," Chip said.

"Where was I?"

"The last paragraph reads, Kief said, 'The molecules of water are always in motion, and many scientists believe that the temperature of the water is determined by the amount of kinetic energy in the water molecules'."

Proge clicked his tongue, closed his eyes, and then resumed his story:

> "Kief, does your Chip Micro have a data table for the molecular kinetic energy in 1.0 kg of water at room temperature?" I said.
>
> "Yes," my brother Kief said, reading off the screen of his phone. "Using traditional measurements, there's about ~201 613 $J_{[IC]}$ of molecular kinetic energy in 1.0 kg of water when it's at room temperature."

“Perfect!” I said, as I began keying information into my phone. “We have 1.0 kg of water with a molecular kinetic energy of ~201 613 $J_{[IC]}$. The equation for kinetic energy is $KE_{[IC]} = \frac{1}{2}mv^2$. Since we already know the amount of kinetic energy, we can use this equation to estimate the velocity of the water molecules in the calorimeter. The calculations for molecular velocity look like this:”

$$\textit{kinetic energy} = \tfrac{1}{2}(\textit{mass})(\textit{velocity})^2$$
$$KE_{[IC]} = \tfrac{1}{2}mv^2$$
$$201\,613 = \tfrac{1}{2}(1)v^2$$
$$\textbf{molecular velocity} = \mathbf{635}\ \frac{\mathbf{m}}{\mathbf{s}}$$

was displayed on my phone.

“The symbol for momentum is ρ,” I said after showing Kief my calculations.

Kief chucked lightly, “rho as in *Pro*’ge.”

“Like I haven’t heard that one before,” I said without pausing—it was probably the 100th time Kief had whispered the pun connecting my nickname to the Greek symbol rho (ρ).

Suddenly, all around us objects started jiggling in response to the rumble of a rocket that was taking off from a launch pad near Tranquility Colony. Kief turned up the music and we waited for the roaring to quiet.

“Now I need to use the molecular velocity to calculate the momentum contained in the water,” I said a few minutes later. I resumed keying in data. “The equation for momentum is $\rho = mv$. Using the velocity of the molecules of water, the calculations for the total amount of molecular momentum in the water are:"

$$momentum = (mass)(velocity)$$

$$\rho = mv$$

$$momentum = (1\ kg)(635\ \frac{m}{s})$$

$$\mathbf{total\ molecular\ momentum = 635\ \frac{kgm}{s}}$$

was displayed on my phone.

"Excellent work, Proge," Kief said after glancing over my calculations. "That's the molecular momentum of the water in the bomb calorimeter, before we burned the black powder. Now you need to account for the fact that when we burned 66 g of black powder, it added 188 882 $J_{[1.2]}$ of molecular kinetic energy to the water."

I keyed the new numbers into my Chip Micro and tilted it so Kief could see the screen. "That increased the molecular kinetic energy to ~233 093 $J_{[IC]}$. The mass was still 1.0 kg, so the calculations for the final velocity of the water molecules after the fuel was burned, become:"

$$kinetic\ energy = ½(mass)(velocity)^2$$

$$KE_{[IC]} = ½mv^2$$

$$390\ 495\ J = ½(1\ kg)v^2$$

$$\mathbf{molecular\ velocity = 883.7\ \frac{m}{s}}$$

was printed on my phone.

"And," I said, "the calculations for the final molecular momentum are:"

$momentum = (mass)(velocity)$

$\rho = mv$

$molecular\ momentum = (1\ kg)(883.7\ \frac{m}{s})$

$\mathbf{molecular\ momentum = 883.7\ \frac{kgm}{s}}$

[For full technical data, use this link to: **Table B** at the end of this chapter.]

"Simple enough," Kief said after examining my calculations. "The 1.0 kg of water had a total starting molecular momentum of 635 kgm/s, and a final momentum of 883.7 kgm/s."

"If we subtract the two figures, then we'll know how much molecular momentum the water gained when we burned the black powder," I said.

"They say that a change in the amount of momentum is always caused by some type of impulse," Kief said. "What do you want to call this?"

"The energy contained in chemical bonds is called Chemical Potential Energy," I said. "So I'll call this, Chemically Bonded Impulse (*CBI*). I'll theorize that this trapped impulse has something to do with electrons and quarks that're spinning and vibrating inside the chemical bonds.

"According to our experiments with the calorimeter," I explained, "the black powder is storing 248.7 kgm/s of Chemically Bonded Impulse inside its chemical bonds. When the black powder burned, the chemically bonded impulse (*CBI*) was released into the water, causing the water molecules to move faster."

"Dynamo, that actually makes sense. Let's launch some rockets!" Kief said, as we walked to the closet where our spacesuits were stored.

"We should make some predictions first," I said.

"Ok," Kief said. "Let's keep this simple. I think about half of the energy stored in the black powder will become light and radiant heat. Most of the remaining chemical/kinetic energy will cause the fuel gasses to go sideways. And only a small amount of chemical/kinetic energy will actually push the rocket forward."

"If most of the fuel produces sideways motion," I said, as I keyed notes into my phone. "Then what do you think of these numbers:"

50% light and radiant heat-energy,
46% sideways molecular kinetic heat-energy,
2% backward exhaust gas kinetic energy.
2% forward rocket kinetic energy

“Those numbers look wonderful,” Kief said after reviewing my notes. “Of course, the only thing we can actually test for is the rocket’s forward kinetic energy. What do you predict about the changes in momentum?”

“I’ll go along with these numbers,” I said. “I’d be more than pleased if our rocket engines are 2% efficient with respect to impulse and momentum.”

“Littl’ Bro,” Kief said, as we began putting on our spacesuits. We checked our data-input gloves to make certain our Chip Micros and visor displays were connected correctly. “Let’s go to the moon rover and see how efficient our black-powder rocket engine is!”

After placing a motion-detector/beacon in the middle of an empty field, we raced our moon rover away from the beacon. I stood, lifted our rocket as high as I could, pointed it toward the motion-detector, let go of the rocket, and activated the launch button on my Chip Micro. With a hiss our rocket blazed toward the beacon.

“I have this one!” Kief said, as data from the motion-detector/beacon began appearing on our visor displays. “We shot the rocket backward, toward the beacon, and our 0.2 kg rocket had an initial velocity of 100 m/s, and a final velocity of –200 m/s. What an awesome acceleration!”

“Should we use the work-energy equation?” I asked, “or the kinetic-energy equation?”

“Both equations should produce the same result. Chemical/kinetic-energy and chemical/work-energy are supposed to be the same thing,” Kief said, as he tapped the finger keys in his data-input glove. “We measured the starting and ending velocities, so let’s use the kinetic-energy equation. The kinetic-energy calculations work like this:”

$$\text{change in kinetic energy} = KE_{final} - KE_{initial}$$
$$\text{change in } KE = \tfrac{1}{2}mv^2_{final} - \tfrac{1}{2}mv^2_{initial}$$
$$\text{change in } KE = \tfrac{1}{2}(0.2\ kg)(-200\ \tfrac{m}{s})^2 - \tfrac{1}{2}(0.2\ kg)(100\ \tfrac{m}{s})^2$$
$$\textbf{change in kinetic energy = 3 000 J}_{\textbf{[0.02]}}$$

appeared on our visor displays.

[For full technical data on this first experiment, use this link to: **Table C** at the end of this chapter.]

I started keying the numbers for impulse [momentum-transfer] into my data-input glove, while Kief worked on the numbers for energy efficiency. “You’re doing great,” I said absentmindedly as I stared in shock at the results of my momentum calculations.

I was glad I was using my personal display, not the joint display. The visors in our space helmets had several digital display areas that we could move around and program as needed.

Kief and I were accustomed to doing our individual calculations in one of the personal display areas, and we would use key commands or voice commands to move information to the joint display area whenever we wanted to share information.

"Now we can calculate the chemical-to-kinetic energy efficiency of our rocket engine," Kief said, unaware of my calculations and surprise. "When using kinetic energy, efficiency is calculated using, actual output divided by ideal output, times 100%."

"We predicted a kinetic-energy efficiency around 2%," I said.

Kief moved his data to the joint display area, "Our numbers for efficiency should look like this:"

$$energy\ efficiency = \frac{energy\text{-}out}{energy\text{-}in} \times 100\%$$

$$efficiency = \frac{change\ in\ Kinetic\ Energy}{Chemical\ Potential\ Energy\ of\ fuel} \times 100\%$$

$$energy\ efficiency = \frac{\Delta KE}{CPE} \times 100\%$$

$$\boldsymbol{energy\ efficiency = \frac{3\ 000\ J}{188\ 882\ J} \times 100\%}$$

$$\boldsymbol{energy\ efficiency\ of\ engine = 1.59\%}$$

appeared in the joint display areas of our visors.

"These numbers show the chemical-to-kinetic energy efficiency was 1.59%. Not great, but close to our predictions," Kief said disappointedly. "What do your momentum figures say?"

I felt my face redden. "I wish I could say they matched… perhaps we should try another test."

Kief raced the rover back to the garage. “Uncle Hal said we could use the hover-rocket anytime we wanted. We’ll use the same motion-detector beacon and a higher starting velocity.”

Can you tell Kief was training to be a pilot? Before long I was standing on the back seat of the hover-rocket as Kief raced past the beacon at 200 m/s. “Thankfully, the moon doesn’t have an atmosphere,” I shouted excitedly as I lifted our 1.0 kg toy rocket high in the air and pointed it at the beacon.

“Now,” I said, as I released our toy rocket and grabbed the sides of the hover-rocket. Kief made a hard-right turn and I activated our toy rocket’s launch button. A cloud of smoke erupted from the back of our toy rocket, and data quickly appeared on our visor displays.

“Good thing Mom isn’t watching,” I said, taking the controls so Kief could do his calculations.

“This time we shot the rocket forward, toward the beacon,” Kief said, as his fingers keyed information into his data-input glove. “This 1.0 kg rocket had an initial velocity of 200 m/s, and a final velocity of 260 m/s.”

“As expected, the heavier rocket didn’t accelerate as much,” I said.

Kief nodded, “But, my calculations show, the chemical-to-kinetic energy efficiency of this rocket engine is 7.31%. See, I’ll move my data table to our joint displays.

Look at the bottom data-line. Ignore the technical info, and focus on the bottom data-line:”

Test 2 – ENERGY (traveling at 200 m/s)	D
F = 75N m = 1.0 kg a = 75 $\frac{m}{s^2}$ t = 0.80 s	
Initial velocity: 200 $\frac{m}{s}$ CPE = 188 882 J$_{[1.2]}$	
Final velocity: $v_i + at = \left(200\frac{m}{s}\right) + \left(75\frac{m}{s^2}\right)(0.8s) = 260\frac{m}{s}$	
Kinetic energy produced by black powder: 13 800 J$_{[0.00435]}$	
Energy efficiency = 13 800 / 188 882 x 100 = **7.31%**	

“That’s strange,” I said, as we stopped to pick up the motion-detector/beacon. “I trust your calculations, but the bottom data-line says it all. The chemical-to-kinetic energy efficiency was 7.31%.”

“I wonder why the percent efficiency changed so much?” Kief said. “It was 1.59% the first time and 7.31% the second time. That’s a huge discrepancy!”

“It should have been the same both times,” I said. “Gravity?”

“Can’t be,” Kief said. “The moon’s gravity is too small to make a difference.”

“And it would have affected both calculations the same,” I said, as I slipped back into my seat. “Too bad we can’t do an experiment in a place where there’s no gravity around to affect the results.”

“The moon’s gravity is too low to matter.”

“But—”

“Wait! There’s one certain way to find out if the energy efficiency is 7.31% or 1.59%,” Kief said, as he pulled back on the control stick and stomped on the accelerator. With a loud roar, the hover-rocket lurched upward, into space.

“Warn me next time,” I squeaked as the g-forces pressed my spacesuit against my chest, squeezing the air out of my lungs.

Fortunately for me, Kief had completed the high-speed portion of his space-pilot training, and he knew enough to stop accelerating before I passed out.

(Kids, don’t try that at home—and if I find out one of my granddaughters ever tries to accelerate that fast you’ll be grounded until you’re a grandmother!)

“Now the challenging part,” Kief said a few hours later. He rotated the hover-rocket backwards and began slowing down. “We need to come to a complete stop on the edge of the zero-gravity zone that hangs between Earth and the moon. That way we can test our toy rocket in a true zero-gravity environment.”

A few minutes later he did precisely that. I attached a tethering cord between my spacesuit and the hover-rocket, unbuckled my seatbelt, pushed away from the hover-rocket, and suspended the motion-detector/beacon on the edge of the zero-gravity zone, as Kief had directed.

“Let’s try the big rocket,” I said, as I tightened my seat belt and thought about what happened the last time our hover-rocket accelerated.

“When I tell you, launch our 3.0 kg toy rocket backward, toward the beacon,” Kief said, as he once again stomped on the accelerator, tossing me back and causing the blood to rush into my head.

The acceleration decreased, and I held our toy rocket high above my head, pointed it backward, and read the data as it appeared on my visor display.

“Now,” Kief shouted when the speedometer read 1 000 m/s.

With a brief puff of smoke, our toy rocket zipped away from us, back toward the motion-detector beacon.

“Now we we’ll know for certain which of our first two efficiency measurements was correct,” Kief said, as we slowed and turned to retrieve the toy rocket and beacon.

I nodded, “It’s always a good idea to conduct the same experiment several times under a wide variety of parameters, before you draw a conclusion.”

“This time we shot the rocket backward, toward the beacon,” Kief said. “Our 3.0 kg rocket had an initial velocity of 1 000 m/s, and a final velocity of 980 m/s.”

“I’ve run the numbers, and the data from the beacon checks out mathematically,” I said. “Force, acceleration, distance, mass, velocity… everything appears normal.”

Kief keyed information into his data-input glove. “The symbol for change in an amount is the Greek letter delta (Δ). If we include that symbol, the equation for change/increase in the amount of kinetic energy looks like this:”

$$\Delta KE = (im\Delta\rho)(speedy)$$

$$\Delta KE = (mv_f - mv_i)\left(\frac{v_{final} + v_{initial}}{2}\right)$$

$$\Delta KE_{[IC]} = \tfrac{1}{2}mv^2_{final} - \tfrac{1}{2}mv^2_{initial}$$

$$\Delta KE_{[IC]} = \tfrac{1}{2}(3\ kg)(980\ \tfrac{m}{s})^2 - \tfrac{1}{2}(3\ kg)(1\ 000\ \tfrac{m}{s})^2$$

change in kinetic energy = –59 400 J$_{[0.001\ 01]}$

appeared in the joint area of our visor displays.

“Now to calculate chemical-to-kinetic energy efficiency,” Kief said, as he keyed in the following:

$$energy\ efficiency = \frac{energy\text{-}out}{energy\text{-}in} \times 100\%$$

$$efficiency = \frac{change\ in\ Kinetic\ Energy}{Chemical\ Potential\ Energy\ of\ fuel} \times 100\%$$

$$energy\ efficiency = \frac{\Delta KE}{CPE} \times 100\%$$

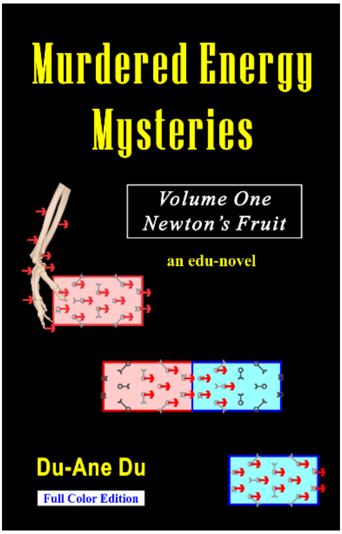
$$energy\ efficiency = \frac{59\ 400\ J}{188\ 882\ J} \times 100\%$$

energy efficiency of rocket engine = 31.4%

[For full technical data on this experiment, use this link to: **Table E** at the end of this chapter.]

“What?” Kief said, “Over 30% efficient!”

Excerpted from:



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“We predicted a chemical-to-kinetic energy efficiency of about 2%,” I said. “An efficiency of 31% does seem wildly high.”

“But why did the value keep changing?” Kief said. “Our first experiment showed only 1.59% energy efficiency. Now we’re showing 31.4% energy efficiency! How can this be happening?”

“Something else is strange,” I said after scanning my momentum data. “Your kinetic energy percentages have been jumping all around my percentages for momentum efficiency.”

“Seriously?” Kief said, as he aimed our hover-rocket at the moon and accelerated gently. “Show me your calculations.”

“As you know, the symbol for momentum is ρ and the symbol for the change in momentum is $\Delta\rho$,” I said—waiting for another ‘rho as in *Pro*’ge pun.

“There are two ways to calculate how much the momentum of the toy rocket changed,” I continued after the slight pause. I started moving information to the joint display area of our visors. “Since we knew the starting and ending velocities, I used the equation that says the amount of momentum change is equal to the final momentum minus the initial momentum:"

$$change\ in\ momentum = mv_{final} - mv_{initial}$$

$$\Delta\rho = (0.2\ kg)(-200\ \frac{m}{s}) - (0.2\ kg)(100\ \frac{m}{s})$$

$$\mathbf{change\ in\ momentum = -60\ \frac{kgm}{s}}$$

Kief nodded. "What about your figures for the chemical-to-momentum efficiency of our rocket engine?"

"The momentum efficiency equation for a rocket engine is momentum-out divided by momentum-in, times 100 percent." I said. "The black powder contained 248.7 kgm/s of stored chemically bonded impulse (*CBI*). Which means, the calculations for the momentum efficiency of our rocket engine are:"

$$momentum\ efficiency = \frac{momentum\text{-}out}{momentum\text{-}in} \times 100\%$$

$$efficiency = \frac{momentum\text{-}increase}{CBI\ of\ fuel} \times 100\%$$

$$momentum\ efficiency = \frac{60\ kgm/s}{248.7\ kgm/s} \times 100\%$$

$$\mathbf{momentum\ efficiency = 24.1\%}$$

"Nicely done, Proge," Kief said. "Your value is higher than our original prediction, but I guess that's ok. How much did your numbers change when we did the other experiments?"

“That’s the fascinating part,” I said, as I activated the data box from our first experiment. “Focus on the bottom data-line. You can ignore the technical data, the important part is the final chemical-to-momentum percentage at the bottom of the table:”

Test 1 – MOMENTUM (traveling at 100 m/s)	**F**
F = –75N m = 0.2 kg a = –375 $\frac{m}{s^2}$ t = 0.80 s	
Initial velocity: 100 $\frac{m}{s}$ ***CBI*** = 248.7 $\frac{kgm}{s}$	
Final velocity: $v_i + at = \left(100\frac{m}{s}\right) + \left(-375\frac{m}{s^2}\right)(0.8s) = -200\frac{m}{s}$	
Momentum increase produced by black powder: **–60$\frac{kgm}{s}$**	
Momentum efficiency = 60 / 248.7 x 100 = **24.1%**	

“This is the first experiment that we did,” Kief said. “And yes, the last line shows that the chemical-to-momentum efficiency was 24.1%. What about the second experiment?”

“As I said, it’s fascinating,” I said, as activated the next data box. “Once again, focus on the bottom data-line. While an engineer may care about the details, all we want to know is the chemical-to-momentum efficiency, and that’s on the bottom line of this table:”

Test 2 – MOMENTUM (traveling at 200 m/s)	**G**

F = 75N m = 1.0 kg a = 75 $\frac{m}{s^2}$ t = 0.80 s

Initial velocity: 200 $\frac{m}{s}$ ***CBI*** = 248.7 $\frac{kgm}{s}$

Final velocity: $v_i + at = \left(200\frac{m}{s}\right) + \left(75\frac{m}{s^2}\right)(0.8s) = 260\frac{m}{s}$

Momentum increase produced by black powder:

$mv_f - mv_i = (1kg)\left(260\frac{m}{s}\right) - (1kg)\left(200\frac{m}{s}\right) = \mathbf{60\frac{kgm}{s}}$

Momentum efficiency = 60 / 248.7 x 100 = **24.1%**

“I’m focusing on the bottom line of your data table,” Kief said with a touch of irritation.

“We performed the second experiment at 200 m/s, and the chemical-to-momentum efficiency was 24.1%,” I said. “And when we performed the third experiment at 1 000 m/s, the chemical-to-momentum efficiency was also 24.1%. See, check out the bottom data-line of our third experiment:”

Test 3 – MOMENTUM (traveling at 1 000 m/s)	**H**

F = –75N m = 3.0 kg a = –25 $\frac{m}{s^2}$ t = 0.80 s

Initial velocity: 1 000 $\frac{m}{s}$ ***CBI*** = 248.7 $\frac{kgm}{s}$

Final velocity: $v_i + at = \left(1\,000\frac{m}{s}\right) + \left(-25\frac{m}{s^2}\right)(0.8s) = 980\frac{m}{s}$

Momentum increase produced by black powder:

$mv_f - mv_i = (3kg)\left(980\frac{m}{s}\right) - (3kg)\left(1\,000\frac{m}{s}\right) = \mathbf{-60\frac{kgm}{s}}$

Momentum efficiency = 60 / 248.7 x 100 = **24.1%**

“Amazing,” Kief said. “In the bottom data-line of this third experiment table, the chemical-to-momentum efficiency is still 24.1%. No matter how fast we traveled when we did the experiment, the efficiency for momentum was always the same.”

“And we can even make a comparison table,” I said, as my fingers quickly keyed data into my data-input glove. “On this next table, I’ll put the chemical-to-energy efficiency in the middle column, and I’ll put the chemical-to-momentum efficiency in the right column. What do you think about this?”

Comparison of Rocket Efficiencies		**I**
Experiment	***Energia*-Energy Efficiency**	**Impulse/Momentum Efficiency**
#1 at 100 m/s	**1.59%**	**24.1%**
#2 at 200 m/s	**7.31%**	**24.1%**
#3 at 1 000 m/s	**31.4%**	**24.1%**

“Our energy percentages are crazy,” Kief said. “The chemical-to-energy efficiency is jumping all over the place, but the numbers for chemical-to-momentum efficiency are all very consistent.”

My eyes widened. “What would happen if…”

“Maybe we can do some high-speed tests while we’re traveling back to Mars,” Kief said excitedly.

> “We’ll need more rockets,” I said, hoping the crew of the Mars transport would give us permission to do some more experiments.
>
> Four days later, the Crew Chief said, “Based on what you’ve told me so far, I’m more than interested in seeing your experiments. One of our operators will notify you when there’s an opportunity to perform another of your experiments. If your results hold up, you boys may want to consider writing this up for a scientific journal…”

* * *

“Are you ok, Sir?” Chip said.

“I’m sorry Chip,” Professor Proge apologized after releasing a big yawn. “I must’ve dozed off.”

Proge finished his sweet iced tea, lifted a pitcher, and began refilling his glass.

“One of the benefits of retirement,” Chip said. “No one cares if you take a little nap.”

“That’s my line, Chip,” Proge said, gently chuckling. Currently in his mid 80’s, Proge had loved teaching so much that he had postponed retirement as long as possible. He secretly hoped to return for one more series of classes.

“Let’s see,” Proge said, quickly searching his memory. “We were talking about the *energia*/energy paradox.”

“Yes, you had finished telling me about the experiment in the zero-gravity pocket that lies between Earth and the moon.”

“Go on,” Proge said.

“And your calculations for chemical-to-momentum efficiency were always consistent, but your brother Kief’s calculations of chemical-to-kinetic energy efficiency were never consistent. It almost seemed as if the rocket fuel contained chemically bonded impulse, but there was no legitimate correlation between kinetic energy and fuel. In other words, chemical/kinetic-energy appears to be improbable.”

“It does appear that way, doesn’t it?” Proge said, as a songbird began whistling in a nearby tree.

“Would the results have been different if Kief had used the work-energy equation instead of the kinetic-energy equation?”

“That question is answered in the last part of the anecdote,” Proge professed. “We’re almost done, by the way.”

“What happened next?”

“Resume recording, Chip,” Proge said, as he leaned back and continued his story:

> A few days later, Kief and I were called to the cargo-bay control room of the Mars transport. It was located in a glass bubble on the side of the ship. One of the cargo

bay doors was half-open, and a large robotic arm extended out of the door and into space. Behind the arm, the moon was now a distant tiny ball, much smaller than Earth.

“As you can see,” the operator said, pointing out a thick concave window. “I’ve attached your smallest toy rocket to the remote arm, and I’m extending it as far from the side of our transport ship as it will go. My name’s Sam, by the way.”

“I’m Kief, and this is my younger brother, Proge,” Kief said with a nod toward me.

“Oh,” Sam said, “my paperwork said Paul.”

“Proge is a nickname,” I said.

“Mom and Dad said he was always progressing forward into new things, so they called him *Prog*ressive Proge.”

Sam grinned, “I see the connection, like momentum is always progressing forward, so some of the later Newtonian scientists used the term ‘progress’ instead of the term momentum.”

“Exactly,” I said, “which’s why we use the Greek letter rho (ρ) as the symbol for momentum.”

“Back to the experiment,” Sam said. “Our transport is coasting toward Mars at 5 000 m/s. We’re approaching a motion-detector beacon that’s directly in front of our ship. We have about 20 minutes before we pass the beacon, so when you're ready, I'll activate your 0.04 kg black-powder rocket."

"How exciting," I said, as I pulled out my phone.

"Where will the data display?" Kief said.

Sam pointed to a computer screen. "The beacon will identify your toy rocket's speed, flight angle, distance traveled during the engine burn, and so forth."

"When you believe we've reached the optimum distance from the beacon," Kief said, as I nodded. "Then fire away!"

Sam glanced at a display screen, pushed a button, and a computer voice said, "Launch sequence activated."

Outside the window, the robot arm released our rocket, and a few seconds later a dense cloud of smoke appeared as the rocket shot forward. Numbers rapidly appeared on the data screen. [For full technical data on this experiment, use this link to: **Table J** at the end of this chapter.]

"How much kinetic energy did the rocket engine produce this time?" I asked as I watched Kief key numbers into his phone.

"This time we launched the rocket forward, toward the beacon," Kief said. "Our rocket had an initial velocity of 5 000 m/s, and a final velocity of 6 500 m/s. The equation for change/increase in the amount of kinetic energy looks like this:"

$$\Delta KE = (im\Delta\rho)(speedy)$$

$$\Delta KE = (mv_f - mv_i)\left(\frac{v_{final} + v_{initial}}{2}\right)$$

$$\Delta KE_{[IC]} = ½mv^2{}_{final} - ½mv^2{}_{initial}$$

$$\Delta KE_{[IC]} = ½(0.04\ kg)(6\ 500\ \tfrac{m}{s})^2 - ½(0.04\ kg)(5\ 000\ \tfrac{m}{s})^2$$

***kinetic energy increase = 345 000 J*[0.000 174]**

was displayed on his touchscreen.

“Now to calculate the chemical-to-kinetic energy efficiency,” Kief said, as he keyed in the following:

$$energy\ efficiency = \frac{energy\text{-}out}{energy\text{-}in} \times 100\%$$

$$efficiency = \frac{change\ in\ Kinetic\ Energy}{Chemical\ Potential\ Energy\ of\ fuel} \times 100\%$$

$$energy\ efficiency = \frac{\Delta KE}{CPE} \times 100\%$$

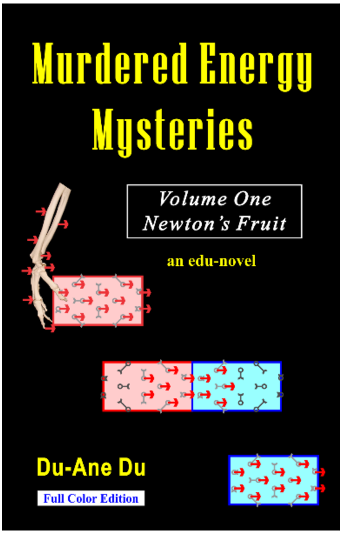
$$energy\ efficiency = \frac{345\ 000\ J}{188\ 882\ J} \times 100\%$$

energy efficiency of rocket engine = 183%

“Seriously?” Operator Sam said. “How can anything have an energy efficiency of 183%? What’re you boys up to?”

“It’s just as I suspected,” Kief said. “For some reason, the mathematics for kinetic energy doesn’t produce consistent answers. It’s as if the calculation of an object’s kinetic energy is dependent on its velocity.”

Excerpted from:



Sam's head shook. "But the amount of chemical/kinetic-energy produced should be entirely—"

"—dependent on the amount of fuel used, not the starting velocity!" Kief said.

"The calculation of an object's energy may also be dependent on where you're standing when you make the measurements," I said.

Kief's brows narrowed. "Worse than that, no matter where you stand, the answer you find is never the same."

"What do you mean you're not finding consistent answers?" Sam said.

"We've done this experiment four times," Kief said. "Once at 100 m/s, once at 200 m/s, once at 1 000 m/s, and now at 5 000 m/s."

"And you keep producing different answers for chemical-to-kinetic energy efficiency?" Sam said. "I may be just an operator, but even I know the efficiency of a rocket engine should never change."

"Let's show him your data on chemical-to-kinetic energy efficiency," I said

Kief nodded. “Look at this, Sam. Our experiments with a calorimeter showed us, 66 g of black powder has a stored heat *energia* of 188 882 J$_{[1.2]}$. But, when we did the rocket experiment while traveling at 100 m/s, the black powder only produced 3 000 J$_{[0.02]}$ of kinetic energy—which’s an efficiency of only 1.59%.”

“Seriously?” Sam said. “A moment ago, you said the chemical-to-kinetic energy efficiency was 183%. How come the numbers changed?”

“Good question. Here’s a data chart of how much kinetic energy was produced by the chemical fuel during each of our four experiments,” I said, as I showed Sam a composite chemical/kinetic-energy data chart from all four experiments. “Focus on the right column, that’s where the percent data is located.”

Kinetic Energy produced by Chemical Potential Energy in black powder (From moving start.)			**K**
	CPE stored in fuel	Kinetic Energy increase of rocket	**Energy efficiency**
#1	188 882 J$_{[1.2]}$	3 000 J$_{[0.02]}$	**1.59%**
#2	188 882 J$_{[1.2]}$	13 800 J$_{[0.004\ 35]}$	**7.31%**
#3	188 882 J$_{[1.2]}$	59 400 J$_{[0.001\ 01]}$	**31.4%**
#4	188 882 J$_{[1.2]}$	345 000 J$_{[0.000\ 174]}$	**183%**

“You know, Kief,” I said. “The numbers in the right, percentage column, are growing incredibly fast. If I didn’t

> know better, I'd say that someone accidentally violated the rules of multi-parabolic mathematics."
>
> "Whatever they are," Kief said, raising an eyebrow. "You're the math master, Proge. And it wasn't me, either! I used the standard physics equations—the way they're supposed to be used!"

"If I may interrupt, Professor," Chip said. "Kief's data corresponds with the girl's **kinetic fact #1 of improbable chemical/kinetic energy.** The fact developed by your granddaughters shows, it's experimentally and mathematically impossible to determine how much chemical/kinetic-energy (chemical/kinetic speedy impulse) is allegedly 'stored' in 1 gram of rocket fuel (joules/g). There's no mathematical correlation between the amount of fuel burned, and the amount of kinetic energy 'generated' by the fuel.

"What cannot be measured, probably doesn't exist," Chip continued, "therefore chemical/kinetic energy is either a philosophical precept, or it's a component of a spiritual belief system."

"Their data is completely expected," Professor Proge confirmed. "In the years 1900 to 2010 and beyond, students, scientists, and corporations performed hundreds of thousands of experiments with toy black-powder rockets. There's absolutely no correlation between kinetic energy and chemical bonds. The belief that chemicals can store multi-parabolic kinetic energy is less than improbable."

"Interesting, please continue with your anecdote," Chip said.

Professor Proge sipped his tea, closed his eyes, and continued his story:

> "Your numbers for chemical-to-kinetic energy efficiency are terribly inconsistent," Sam said. "I once heard that there may be six different definitions of *energia*/energy. Perhaps the problem lies in a conflict between the different definitions for energy."
>
> "Work energy?" I said.
>
> "It could be," Kief said. "The equation for work-energy is (work) = (mass)(acceleration)(distance). Give me a minute to crunch the numbers for chemical/work-energy efficiency."
>
> "Does the fact that you were moving during the experiment matter?" Sam said.
>
> "The equations are supposed to be designed so that it shouldn't matter if you're moving," Kief said. "I see what you mean, it's called relative motion. In every experiment, we had a moving starting position relative to the motion-detector beam."
>
> "Would it have been possible to make the measurements from the window we're looking out of?" Sam said.

“Yes,” Kief said. “Measuring from our position here by the window would establish a perspective relating to a stationary starting position.”

“If the kinetic energy came from the fuel,” I said, “Then the values for energy change should be the same when viewed either from the motion-detector beacon or from here by the window. In fact, if several space transports passed us during the experiment, then an observer on each of the transports should have recorded the exact same results as the beacon recorded.”

As Kief worked on his numbers, I looked out the window and watched a distant cluster of stars pass behind Earth, and I wondered how long it would be before I would once again visit the great watery sphere.

“Been away long?” Sam asked as he join me in staring at Earth.

“Five years,” I said. “We’re heading back to our home in Mars Colony—I like small towns, and Mars Colony still has a vibrant pioneer spirit.”

“I’ve completed the calculations for chemical/work energy, as seen from our position here on the rocket,” Kief said, showing us his phone. “In our last experiment, the toy rocket’s engine produced an acceleration of 1875 m/s^2 for 0.80 s. Before we can calculate the amount of work done, we’ll need to know the distance that the toy rocket traveled while its engine was burning the black powder—and we’re going to do the calculations as if we're viewing it from this window. That means the starting velocity was zero, and the calculations look like this:"

$$distance = vt + \frac{1}{2}at^2$$

$$d = \left(0\,\frac{m}{s}\right)(0.8\ s) + \frac{1}{2}\left(1875\,\frac{m}{s^2}\right)(0.8\ s)^2$$

$$d = (0\ m) + \frac{1}{2}(1200\ m)$$

$$\boldsymbol{distance = 600\ meters}$$

appeared on Kief's phone.

"Simple enough," Sam said. "Relative to our position at the window, the rocket traveled a distance of 600 m. Why is the distance important?"

"The equation for work-energy is (*work*) = (*mass*) (*acceleration*) (*distance*)," I said. "Work is supposed to be a version of multi-parabolic energy, just like kinetic energy."

"Exactly," Kief said, thumb scrolling his touchscreen to an older set of calculations. "The toy rocket we used today had a mass of 0.04 kg. I can put today's information into the work equation like this:"

$$work_{[IC]} = (mass)(acceleration)(distance)$$

$$work_{[IC]} = (0.04\ kg)\left(1875\,\frac{m}{s^2}\right)(600\ m)$$

$$\boldsymbol{work_{[IC]} = 45\ 000\ J_{[0.0040]}}$$

appeared on Kief's phone.

"Are the calculations based on our position by the window and the work equation more reliable?" Sam said after viewing Kief's calculations.

"I programmed Chip to calculate the stationary or window-view of the work-energy in each of our four experiments," Kief said, as he activated another page. "This work-done chart also shows the chemical-to-work energy efficiency numbers for each experiment. Look at the percentages in the right column. A technically minded person may care about my calculations, but all we need to focus on is the right column:"

Work-Energy done on rocket by Chemical Potential Energy in black powder (From stationary start.)			**L**
	CPE in fuel	Work (*mad*) done on rocket	**Work eff.**
1	188 882 J[1.2]	$(0.2kg)\left(-375\frac{m}{s^2}\right)(-120m) = 9\,000J_{[0.006\,67]}$	**4.76%**
2	188 882 J[1.2]	$(1kg)\left(75\frac{m}{s^2}\right)(24m) = 1\,800J_{[0.033]}$	**0.95%**
3	188 882 J[1.2]	$(3kg)\left(-25\frac{m}{s^2}\right)(-8m) = 600J_{[0.10]}$	**0.32%**
4	188 882 J[1.2]	$(0.04kg)\left(1875\frac{m}{s^2}\right)(600m) = 45\,000J_{[0.0040]}$	**23.8%**

Sam pointed to the right column, "The joules[IC] of work-energy are different from your earlier calculations! How can the amount of energy allegedly produced by the fuel be different when examined from different points of view? And look at the chemical-to-work energy efficiency column, there on the right."

"Here," Kief said, as he tapped a table-merge icon. "This merged table will show the kinetic energy allegedly produced in all four experiments as compared to the work-energy allegedly produced when viewed from a stationary position. The chemical-to-kinetic and chemical-to-work percentages are in bold print. Focus on the numbers in bold print—they should match each other, but they don't!"

Kinetic Energy vs. Work-Energy produced by Chemical Potential Energy in black powder				**M**
	Moving Start		**Stationary Start**	
	Kinetic Energy increase	**Energy efficiency**	Work produced	**Work efficiency**
#1	3 000 J$_{[0.02]}$	**1.59%**	9 000 J$_{[0.006\ 67]}$	**4.76%**
#2	13 800 J$_{[0.004\ 35]}$	**7.31%**	1 800 J$_{[0.033]}$	**0.95%**
#3	59 400 J$_{[0.001\ 01]}$	**31.4%**	600 J$_{[0.10]}$	**0.32%**
#4	345 000 J$_{[0.000\ 174]}$	**183%**	45 000 J$_{[0.004\ 0]}$	**23.8%**

"Look at the percent column on the right," I said. "The chemical-to-work energy efficiency was lower in experiments 2 and 3, when the mass of the rocket was higher. And the chemical-to-work energy efficiency jumps dramatically higher in experiments 1 and 4, when the toy rockets had a lower mass. If you ask me, it still looks like someone has violated one of the rules of multi-parabolic mathematics."

"I apologize for interrupting, Professor," Chip said. "But I can't help but notice that another scientific fact has been verified. Isn't there a **kinetic fact #3 of improbable**

chemical/work energy? According to fact #3, it's experimentally and mathematically impossible to determine how much chemical/work-energy is 'stored' in 1 gram of rocket fuel (J/g). There's no mathematical correlation between the amount of fuel burned, and the amount of work-energy 'generated' by the fuel.

"What cannot be measured, probably doesn't exist," Chip continued, "therefore chemically stored work-energy is either a philosophical precept, or it's a component of a spiritual belief system."

"It's as I said before," Professor Proge remarked. "In the years 1900 to 2010 and beyond, students, scientists, and corporations performed hundreds of thousands of experiments with toy black powder rockets. There's no experimental or mathematical correlation between work-energy and chemical bonds. The belief that chemicals can store multi-parabolic work-energy is less than improbable."

"Got it," Chip said.

"However, since we're on the topic," Proge said. "The same hundreds of thousands of experiments, all showed that there is a direct correlation between the amount of impulse [momentum-transfer] produced and the amount of fuel used. *In fact, black-powder fuel is usually rated and sold based on the amount of impulse available in the fuel.*"

"So," Chip said. "That means there're hundreds of thousands of experiments which support Hectii's **kinetic fact #2 of chemically bonded impulse**. Fact #2 tells us, burning the chemicals in a given brand of rocket fuel always produces a specific amount of impulse [momentum transfer] per gram (ρ/g).

"The mathematical relationship between chemically bonded impulse (*CBI*) and grams of fuel is:

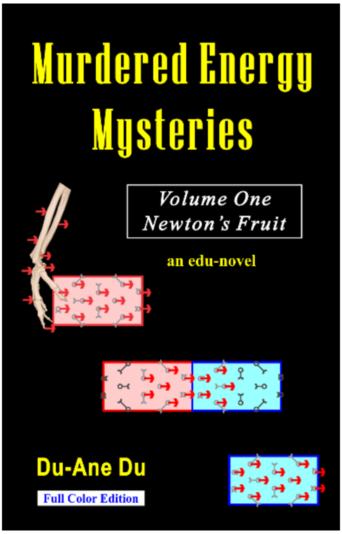
$$\underline{CBI} = im\Delta\rho = k_{\rho/g}\ [\text{grams of fuel}]$$

"According to this equation, there is an exclusive correlation between the grams of fuel burned and the amount of impulse released by the fuel. Therefore, chemically bonded impulse can be measured based on grams of fuel.

"Things that can be measured, do exist in the natural world," Chip continued. "Therefore prior to burning, the fuel must be storing the trapped impulse in its chemical bonds. That means chemically bonded impulse exists in the natural world." [Chemical bonds also store standard linearized H&E-joules[1.2]—see Part 3: Mysteries of Murdered Heat Energy.]

"The fact about chemically stored impulse was well established by the mid 1900's," Proge confirmed. "However, the politics prevalent in that era prevented scientists from admitting the existence of stored impulse. This same political environment forced scientists to continue teaching the improbable concepts of chemical/kinetic-energy and chemical/work energy."

Excerpted from:



Examine or purchase at Amazon.com

"Fascinating," Chip said. "Too bad there isn't… or perhaps there is. Professor, I noticed that in your story, Kief's data for work-energy was different from his data for kinetic energy. Is it possible to develop an equation that shows how much work-energy can be produced by a specific number of grams of rocket fuel?"

"Of course," Proge said as he rapidly thumb-keyed data into his Chip Micro's touchscreen. "In our last conversation, Hectii developed an equation for the energy (speed infused impulse) produced by the Chemical Kinetic Energy allegedly stored in rocket fuel. It looked like this:"

$$CKE_{\mathrm{[IC]}} \cong (im\Delta\rho)(speedy)$$

$$CKE_{\mathrm{[IC]}} \cong (im\Delta\rho)(\frac{v_{final} + v_{initial}}{2})$$

$$CKE_{\mathrm{[IC]}} \cong k_{\rho/g}\,[grams\ fuel\ burned](\frac{v_{final} + v_{initial}}{2})$$

$$CKE_{\mathrm{[IC]}} \cong k_{\rho/g}\,[grams\ fuel\ burned](average\ velocity)$$

appeared on Chip's screen.

"This equation is based on the idea that the grams of fuel store a specific amount of trapped impulse," Chip said. "In other words:"

$$im\Delta\rho = k_{\rho/g}\,[grams\ of\ fuel]$$

appeared on Chip's screen.

"Exactly, that equation shows if you know the number of grams of fuel, you can calculate the amount of impulse that will be produced when the fuel is burned," Proge said as he resumed keying. "And that's also the key to this next simple derivation. We'll start with the equation for work-energy that Kief used, and the definition of a contac- ρ-force-rate. If I merge the two, we get:"

$$Chemical\ Work\text{-}Energy \cong \underline{\boldsymbol{F}}d$$

$$\underline{\boldsymbol{F}}orce\text{-}rate \cong \frac{im\Delta p}{t}$$

$$CWE \cong \frac{im\Delta p}{t}(d)$$

$$\boldsymbol{CWE \cong im\Delta p\frac{distance}{time}}$$

appeared on Chip's screen.

"Next, we substitute in the grams of fuel equation that Hectii developed the other day," Proge continued, "And we end up with:"

$$im\Delta\rho = k_{\rho/g}\,[\text{grams of fuel}]$$

$$\text{Chemical Work-Energy} \cong k_{\rho/g}\,[\text{grams of fuel}]\,\frac{\text{distance}}{\text{time}}$$

$$CWE \cong k_{\rho/g}\,[\text{grams of fuel}](\text{average velocity})$$

appeared on Chip's screen.

"Which tells us the amount of work done by a given amount of fuel is dependent on the distance traveled and the amount of time involved," Chip said. "That means grams of chemical/work-energy is a mathematically impossible concept, because it is velocity dependent."

"Precisely," Proge said.

"But Kief's numbers for chemical/work-energy and chemical/kinetic-energy involved changes in velocity," Chip said. "Is there a way to adjust this work-energy equation so it relates grams to velocity rather than grams to distance?"

"That would be easy," Proge said. "We simply substitute a different definition for average velocity:"

$$CKE_{[\text{IC}]} \cong k_{\rho/g}\,[\text{grams fuel burned}](\text{average velocity})$$

$$CKE_{[\text{IC}]} \cong k_{\rho/g}\,[\text{grams fuel burned}]\left(\frac{\text{distance}}{\text{time}}\right)$$

$$CKE_{[\text{IC}]} \cong k_{\rho/g}\,[\text{grams fuel burned}]\left(\frac{v_{final} + v_{initial}}{2}\right)$$

"So you see," Proge said. "Once again, it is clear that there is not an exclusive correlation between grams of fuel and chemical/work-energy ‘generated’. This is indisputable mathematical proof that the concept of chemical/work-energy is only a philosophical precept.”

“I believe that Pico would observe that this proves *the idea of chemical/work-energy is a murdered myth*.”

Proge chuckled, “I suppose this is energy murder number two.”

“How does this relate to my earlier question?”

“Simple,” Prog explained, “you were asking why Kief’s work-energy data kept changing. The equation says it all. The amount of work-energy produced during an experiment is the impulse times the average velocity, what Pico keeps calling speedy impulse. Every experiment we did had a different average velocity.”

“So the results for the amount of work-energy produced changed every time you did an experiment at a new average velocity.”

“Precisely.”

“Fascinating. Tell me, is there more to your anecdote?” Chip asked. “According to my transcript, your last two paragraphs were:”

> “Here,” Kief said, as he tapped a table-merge icon. “This merged table will show the kinetic energy allegedly produced in all four experiments as compared to the

work-energy allegedly produced when viewed from a stationary position. The chemical-to-kinetic and chemical-to-work percentages are in red. Focus on the numbers in red—they should match each other, but they don't!"

Kinetic Energy vs. Work-Energy produced by Chemical Potential Energy in black powder				**M**
	Moving Start		**Stationary Start**	
	Kinetic Energy increase	**Energy efficiency**	Work produced	**Work efficiency**
#1	3 000 J$_{[0.02]}$	**1.59%**	9 000 J$_{[0.006\ 67]}$	**4.76%**
#2	13 800 J$_{[0.004\ 35]}$	**7.31%**	1 800 J$_{[0.033]}$	**0.95%**
#3	59 400 J$_{[0.001\ 01]}$	**31.4%**	600 J$_{[0.10]}$	**0.32%**
#4	345 000 J$_{[0.000\ 174]}$	**183%**	45 000 J$_{[0.004]}$	**23.8%**

"Look at the percent column on the right," I said. "The chemical-to-work energy efficiency was lower in experiments 2 and 3, when the mass of the rocket was higher. And the chemical-to-work energy efficiency jumps dramatically higher in experiments 1 and 4, when the toy rockets had a lower mass. If you ask me, it still looks like someone has violated one of the rules of multi-parabolic mathematics."

"Ah yes," Proge said as he closed his eyes and resumed his story:

"Perhaps there's been a violation of a poorly understood math rule," my brother Kief said, his voice filled with bewilderment. “We used the same amount of fuel with each experiment, but the numbers for energy allegedly produced are different every time. Look at the values for joules$_{[IC]}$ of kinetic energy, the amount of energy allegedly produced rises dramatically with each experiment.”

“Which suggests the energy is not coming from the fuel,” Sam whispered.

“And different frames of reference produce different answers for energy efficiency,” I said.

“What does this tell you about the reliability of the equations you’ve been using?” Sam said.

“The momentum equations I used always produced consistent answers,” I said. “All four experiments showed a chemical-to-momentum efficiency of 24.1%.”

Kief sighed heavily. “But the kinetic-energy equation and the work-energy equation produced inconsistent answers for the same amount of fuel. There’s no correlation between kinetic energy and grams of chemical fuel, and there’s no correlation between work-energy and grams of chemical fuel.”

“Perhaps Proge is right about the math thing,” Sam said. “Maybe someone accidentally violated a poorly understood math rule.”

“The rules of multi-parabolic mathematics,” I said softly. “But which rule did they violate, and why?”

“*Prog*ressive *Prog*e is always thinking ahead,” Kief said, playfully slapping my shoulder. “The original equations for kinetic energy and potential energy were developed over three hundred years ago by some of the early Newtonian scientists.”

“Did the Newtonian scientists do high-velocity tests of their equations?” Sam asked.

“The philosophers Gottfried Leibniz and Sir Isaac Newton both lived 200 years before the automobile was invented,” Kief said. “And 100 years before water molecules were discovered.”

“Back then they still thought there were only four elements,” I said. “Earth, wind, air, and fire—and *energia*/energy may be the modern version of the Greek philosophical element, fire.”

“The Newtonian scientists didn’t know about atoms or electrons,” Kief said. “The philosophers Newton and Leibniz were also the first to use calculus.”

“Which means they knew nothing about the rules of multi-parabolic mathematics,” I said.

“They could easily have made a tiny false assumption,” Sam said. “Perhaps a false math assumption, an assumption regarding atoms and elements, or an assumption about the effect of high velocities on their equations.”

I nodded. “Back then, the primary means of transportation was walking, and the fastest thing they ever saw was a running horse.”

“Or a flying cannon ball,” Kief said. “But the point is, Newton, Leibniz, and the other Newtonian scientists wouldn’t have done any high-velocity tests of their equations.”

“They also had very poor measuring tools three hundred years ago, and accurate clocks were rare,” Sam said. “That suggests, a small false assumption in the energy equations could’ve gone unnoticed for hundreds of years.”

“What about the definition of heat *energia*?” I said. “We used a calorimeter to find out how much heat *energia* the black powder produced.”

“Same problem,” Kief said. “The experiments demonstrating that heat is work-done were performed by James Prescott Joule. He claimed that repeated performances of the same experiment showed that work-done can cause a liquid’s temperature to rise.”

“And we just demonstrated that the work-energy equations sometimes produces unreliable answers,” I said. “Maybe he should have done different experiments, rather than doing the same experiment over and over?”

“This is way out of my league,” Sam said with a shake of his head. “Gentlemen, may I make one suggestion?”

> “Of course,” I said.
>
> “You two may have stumbled upon a tiny cancer-like error that could involve several levels of science,” Sam said. “No one wants to discover they have cancer, unless they also know that there’s a cure.”
>
> “So… should we keep the *energia*/energy paradox a secret?” I said.
>
> “Find the cure first,” Sam said. “Don’t announce that you’ve found a cancer-like energy paradox until you can first announce the cure.”

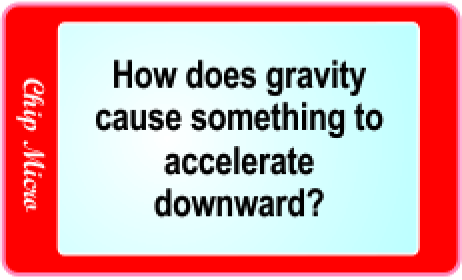
Proge opened his eyes, stretched his arms, and took a deep breath of the fresh sea breeze. “Chip, you can stop recording now.” Proge took a long sip of sweet tea. “Kief and I worked on the *energia*/energy paradox for several years. We found where and how the first tiny error occurred, and we eventually developed the mathematical proofs needed to solve the mystery. And yes, we also found the cure.”

“I must say, the story of your younger days was quite an interesting anecdote,” Chip said. “I’ll title it, *The Energia/Energy Paradox*, or perhaps *The Experiment Leibniz Forgot to Perform*?”

“*Energia/Energy Paradox* is fine,” Proge decided.

“Quite,” Chip said. “I’ll put the anecdote in your memoirs file. Your publisher will be pleased, and I’m certain your grand-daughters will be delighted to read it someday.”

“Thanks Chip,” Proge said appreciatively. “Speaking of my grand-daughters, let’s activate their phone/activity log and see what my three little diamonds are up to.”



How does gravity cause something to accelerate downward?

[SKIP TO NEXT CHAPTER 202]

ROCKET EXPERIMENTS

Data Tables

Fuel & Engine Data	A
Hex-C11 rocket engine	Fuel: 66.0 g black powder
Average force: 75 newtons	Burn time: 0.80 seconds
Black powder chemical energy (CPE): 188 882 joules[1.2]	

[Bookmark for Table 201-B.]

1 kg H_20 in Bomb Calorimeter	**B**
Initial molecular kinetic energy:	**~201 613 J[IC]**
Final molecular kinetic energy:	**~390 495 J[IC]**
Initial molecular momentum:	**$635\,\frac{kgm}{s}$**
Final molecular momentum:	**$883.7\,\frac{kgm}{s}$**
Chemical Potential KE (CPE) in fuel:	**188 882 J[1.2]**
Chemically Bonded Impulse (CBI) in fuel:	**$248.7\,\frac{kgm}{s}$**

[Return to text for Table B.]

EXPERIMENT 1:

[Bookmark for Table 201-C.]

Test 1 – ENERGY (traveling at 100 m/s)	**C**
F = –75N m = 0.2 kg a = $-375\,\frac{m}{s^2}$ t = 0.80 s	
Initial velocity: $100\,\frac{m}{s}$ CPE = 188 882 J[1.2]	
Final velocity: $v_i + at = \left(100\frac{m}{s}\right) + \left(-375\frac{m}{s^2}\right)(0.8s) = -200\frac{m}{s}$	
Kinetic energy produced by black powder: 3 000 J[0.02]	
Energy efficiency = 3 000 / 188 882 x 100 = **1.59%**	

[Return to text for Table C.]

Test 1 – MOMENTUM (traveling at 100 m/s)	**F**

F = –75N m = 0.2 kg a = –375 $\frac{m}{s^2}$ t = 0.80 s

Initial velocity: 100 $\frac{m}{s}$ ***CBI*** = 248.7 $\frac{kgm}{s}$

Final velocity: $v_i + at = \left(100\,\frac{m}{s}\right) + \left(-375\,\frac{m}{s^2}\right)(0.8s) = -200\,\frac{m}{s}$

Momentum increase produced by black powder: **–60$\frac{kgm}{s}$**

Momentum efficiency = 60 / 248.7 x 100 = **24.1%**

EXPERIMENT 2:

Test 2 – ENERGY (traveling at 200 m/s)	**D**

F = 75N m = 1.0 kg a = 75 $\frac{m}{s^2}$ t = 0.80 s

Initial velocity: 200 $\frac{m}{s}$ CPE = 188 882 J[1.2]

Final velocity: $v_i + at = \left(200\,\frac{m}{s}\right) + \left(75\,\frac{m}{s^2}\right)(0.8s) = 260\,\frac{m}{s}$

Kinetic energy produced by black powder: 13 800 J[0.004 35]

Energy efficiency = 13 800 / 188 882 x 100 = **7.31%**

Test 2 – MOMENTUM (traveling at 200 m/s)	**G**

F = 75N m = 1.0 kg a = 75 $\frac{m}{s^2}$ t = 0.80 s

Initial velocity: 200 $\frac{m}{s}$ ***CBI*** = 248.7 $\frac{kgm}{s}$

Final velocity: $v_i + at = \left(200\,\frac{m}{s}\right) + \left(75\,\frac{m}{s^2}\right)(0.8s) = 260\,\frac{m}{s}$

Momentum increase produced by black powder:

$$mv_f - mv_i = (1kg)\left(260\,\frac{m}{s}\right) - (1kg)\left(200\,\frac{m}{s}\right) = \mathbf{60\,\frac{kgm}{s}}$$

Momentum efficiency = 60 / 248.7 x 100 = **24.1%**

EXPERIMENT 3:

[Bookmark for Table 201-E.]

Test 3 – ENERGY (traveling at 1 000 m/s)	**E**
F = –75N m = 3.0 kg a = –25 $\frac{m}{s^2}$ t = 0.80 s	
Initial velocity: 1 000 $\frac{m}{s}$ CPE = 188 882 J[1.2]	
Final velocity: $v_i + at = \left(1\,000\frac{m}{s}\right) + \left(-25\frac{m}{s^2}\right)(0.8s) = 980\frac{m}{s}$	
Kinetic energy produced by black powder: –59 400 J[0.001 01]	
Energy efficiency = 59 400 / 188 882 x 100 = **31.4%**	

[Return to text for Table E.]

Test 3 – MOMENTUM (traveling at 1 000 m/s)	**H**
F = –75N m = 3.0 kg a = –25 $\frac{m}{s^2}$ t = 0.80 s	
Initial velocity: 1 000 $\frac{m}{s}$ ***CBI*** = 248.7 $\frac{kgm}{s}$	
Final velocity: $v_i + at = \left(1\,000\frac{m}{s}\right) + \left(-25\frac{m}{s^2}\right)(0.8s) = 980\frac{m}{s}$	
Momentum increase produced by black powder: $mv_f - mv_i = (3kg)\left(980\frac{m}{s}\right) - (3kg)\left(1\,000\frac{m}{s}\right) = \mathbf{-60\frac{kgm}{s}}$	
Momentum efficiency = 60 / 248.7 x 100 = **24.1%**	

EXPERIMENT 4:

[Bookmark for Table 201-J.]

Test 4 – ENERGY (traveling at 5 000 m/s) **J**

F = 75N m = 0.04 kg a = 1875 $\frac{m}{s^2}$ t = 0.80 s

Initial velocity: 5 000 $\frac{m}{s}$ CPE = 188 882 J[1.2]

Final velocity: $\left(5\,000\frac{m}{s}\right)+\left(1875\frac{m}{s^2}\right)(0.8s)=6\,500\frac{m}{s}$

Kinetic energy produced by black powder: 345 000 J[0.000 174]

Energy efficiency = 345 000 / 188 882 x 100 = **183%**

[Return to text, after Table J.]

Test 4 – MOMENTUM (traveling at 5 000 m/s) **N**

F = 75N m = 0.04 kg a = 1875 $\frac{m}{s^2}$ t = 0.80 s

Initial velocity: 5 000 $\frac{m}{s}$ ***CBI*** = 248.7 $\frac{kgm}{s}$

Final velocity: $\left(5\,000\frac{m}{s}\right)+\left(1875\frac{m}{s^2}\right)(0.8s)=6\,500\frac{m}{s}$

Momentum increase produced by black powder:

$(0.04kg)\left(6\,500\frac{m}{s}\right)-(0.04kg)\left(5\,000\frac{m}{s}\right)=\mathbf{-60\frac{kgm}{s}}$

Momentum efficiency = 60 / 248.7 x 100 = **24.1%**

COMPOSITE RESULTS:

Comparison of Rocket Efficiencies **I**

Experiment	*Energia*-Energy Efficiency	Impulse/Momentum Efficiency
#1 at 100 m/s	**1.59%**	**24.1%**
#2 at 200 m/s	**7.31%**	**24.1%**
#3 at 1 000 m/s	**31.4%**	**24.1%**

Kinetic Energy produced by Chemical Potential Energy in black powder (From moving start.)			**K**
	CPE stored in fuel	Kinetic Energy increase of rocket	**Energy efficiency**
#1	188 882 $\text{J}_{[1.2]}$	3 000 $\text{J}_{[0.02]}$	**1.59%**
#2	188 882 $\text{J}_{[1.2]}$	13 800 $\text{J}_{[0.004\ 35]}$	**7.31%**
#3	188 882 $\text{J}_{[1.2]}$	59 400 $\text{J}_{[0.001\ 01]}$	**31.4%**
#4	188 882 $\text{J}_{[1.2]}$	345 000 $\text{J}_{[0.000\ 174]}$	**183%**

Work-Energy done on rocket by Chemical Potential Energy in black powder (From stationary start.)			**L**
	CPE in fuel	Work (*mad*) done on rocket	**Work eff.**
#1	188 882 $\text{J}_{[1.2]}$	$(0.2kg)\left(-375\frac{m}{s^2}\right)(-120m) = 9\ 000J_{[0.006\ 67]}$	**4.76%**
#2	188 882 $\text{J}_{[1.2]}$	$(1kg)\left(75\frac{m}{s^2}\right)(24m) = 1\ 800J_{[0.033]}$	**0.95%**
#3	188 882 $\text{J}_{[1.2]}$	$(3kg)\left(-25\frac{m}{s^2}\right)(-8m) = 600J_{[0.10]}$	**0.32%**
#4	188 882 $\text{J}_{[1.2]}$	$(0.04kg)\left(1875\frac{m}{s^2}\right)(600m) = 45\ 000J_{[0.004]}$	**23.8%**

Kinetic Energy vs. Work-Energy produced by Chemical Potential Energy in black powder				**M**
	Moving Start		**Stationary Start**	
	Kinetic Energy increase	**Energy efficiency**	Work produced	**Work efficiency**
#1	3 000 J$_{[0.02]}$	**1.59%**	9 000 J$_{[0.006\ 67]}$	**4.76%**
#2	13 800 J$_{[0.004\ 35]}$	**7.31%**	1 800 J$_{[0.033]}$	**0.95%**
#3	59 400 J$_{[0.001\ 01]}$	**31.4%**	600 J$_{[0.10]}$	**0.32%**
#4	345 000 J$_{[0.000\ 174]}$	**183%**	45 000 J$_{[0.004]}$	**23.8%**

CONCLUSION: 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 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.)

More information, see:
Murdered Energy Mysteries,
an edu-novel

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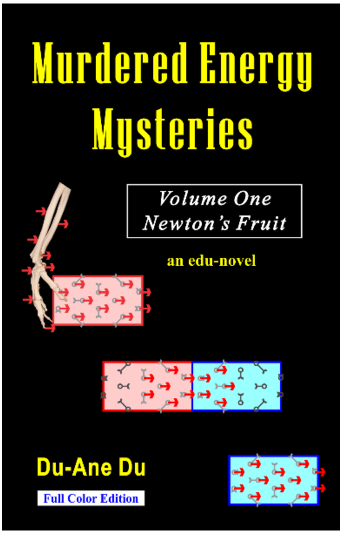

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