“The Case of the Missing Joules”

An energy conversion mystery

It was Friday afternoon at the detective agency, and we were all looking forward to the weekend. If the phone stayed quiet and no one came through that door, we’d be out into the sunshine in less than an hour. But it wasn’t meant to be. Not this weekend.

The phone rang and I reluctantly picked it up. “Hello,” I said very flatly. “You’ve reached the Decent Detective Agency. No one is here right now to take your call. If you leave your name and--”

“Smith!” came the voice at the other end. “This is Sergeant Argent down at headquarters. I know you’re there! I’ve got an emergency at the power plant. There’s a million joules missing. Probably stolen. Get down here on the double!” Click.

I hated to be the bearer of bad news, but I had no choice. “Well, guys, looks like we’ll be tracking joules this weekend.”

“Don’t tell me the crown jewels are missing again,” groaned Lefty.

“She can get along without them for a while,” said Righty.

“No,” I said, “this time it’s joules, not jewels. You know, joules, as in energy units. Make sure we’ve got conversion tables in our gear. Let’s go.”

As we arrived at the power plant we couldn’t see anything unusual. The supervisor met us at the door. “Thanks for coming, gentlemen,” he said.

“Can you show us to the scene of the crime?” I asked.

“Not really,” he said. “You see, energy is invisible. We don’t really know what happened. All we know is that a million joules are missing.”

“Any clues at all?” asked Lefty.

“Our only lead,” said the supervisor, “is that one of our employees quit at exactly 3:00, the same time that we realized the joules were missing.”

“So you think he took them?” asked Righty.

“That’s a possibility,” he said.

“What was the employee’s name?” I asked.

“John Doe.”

This clue was all I needed to start the chase. “That’s one of the aliases used by the notorious energy thief, Jon Dough. Come on, guys. We’ve got a criminal to catch.”

The supervisor had one warning for us. “You know, of course, how hard it will be to find the evidence. Energy can change forms all the time.”

“That’s okay,” I called back as we peeled out of the parking lot. “I’ve got conversion tables!”

The tires screeched and we were off. We had dealt with Jon Dough before. He had robbed a bakery last year, and a bank the year before. We knew right where to start our search: the county fair. Dough’s favorite trick was to get lost in a crowd.

As soon as we pulled into the fairgrounds, Lefty spotted him. “There’s that ring head! Standing in front of the cotton candy booth!”

“That’ll be his first conversion,” I wagered. “He’ll try to throw us off by converting the joules into food calories.”

“Maybe he’s just in line,” said Righty.

“Get out the conversion tables, Lefty,” I said. “Tell me how many kilocalories a million joules will make.”

Lefty glanced at the tables. “To convert joules to kilocalories, you multiply by .0002389. That’s one million times .0002389. That’s a big calculation.”

“It’s easy,” I said. “Just think of it the other way around. It’s .0002389 times a million. Just slide the decimal point over six places. That makes 238.9 food calories. So we’re looking for about 240 calories.

“How much does a bag of cotton candy weigh?” I asked Righty, knowing he had extensive experience with cotton candy.

“65 grams,” he said as he wistfully watched the cotton candy being made.

“That’s it!” I announced. “If you multiply the weight of the sugar times the amount of calories in each gram, you get 240! That’s exactly the amount of energy we are looking for. Undoubtedly, Dough is converting those joules into food calories to throw us off the trail!”

Just then, Dough left the vending stand. Sure enough, he was holding a big wad of cotton candy.

“Look, he’s not even eating it,” said Lefty.

“We’ll follow him closely, before we nab him,” I said. “We have to get more evidence.”

Our suspect headed for the animal judging tent. We followed him in and watched his every move.

I was carefully observing a female suspect on the other side of the arena when Righty slapped me on the arm. “Look! Look!” he said. “He’s feeding the cotton candy to a horse!”

Sure enough, there was Dough, holding the candy while the horse munched away.

“There goes our evidence!” moaned Lefty.

“Not so fast,” I said. “Get out the conversion tables again. Convert kilocalories into horsepower.”

Lefty looked it up and Righty did the math.

“240 times .00156. The answer is .374 horsepower per hour.”

“Hmm...” I mused.

Our suspect was talking to the owner of the horse. The owner untied the horse and began leading it to the competition area. The pulling contest was about to begin. The horse was hitched to a sled with a weight sitting on it. A voice over the loud-speaker began to announce, “Ladies and gentlemen, the pulling contest will now begin.”

I thought fast. “Using the conversion of one horsepower equal to 33,000 foot-pounds per minute, that means if this horse pulls that 1000-pound weight for 11.45 feet, we may have enough evidence to at least start an investigation.”

The horse began pulling. It pulled the half-ton weight exactly 11.45 feet, then stopped.

“We’ve got him!” cried Lefty.

“Get out the handcuffs!” yelled Righty.

“Not so fast, guys,” I said. “What do we have for evidence? All the energy has now been converted into motion, plus a little heat from friction. How are we going to take that to court? We can say we saw it, but we don’t have any hard evidence.”

“You mean he’s going to get away with it?” asked Lefty.

“The visible evidence is gone,” I said.

“That dastardly Dough is a mastermind of crime!” said Righty.

“That’s the advantage of doing energy crimes,” I explained. “You traded the energy around into different forms, but it eventually ends up as non-recoverable things such as movement or heat. Motion and heat and happening one minute and are gone forever the next.”

“So he got away with it,” said Lefty.

“Yeah, this time,” I said. “Maybe next time he’ll make a mistake and we can catch him with potential energy on his person. We’ll call into the station tonight and report the situation to the Sergeant.”

“Hey! It’s after five o’clock!” said Righty. “Since we are already here, how about a Friday night out at the county fair?”

“Sounds like a plan to me,” I replied.

At the bottom of this sheet is a copy of the Decent Detective Agency's energy conversion table. Use this table to help the detectives get a head start on their next week of work. Thanks!

On Monday, they will need to know how many joules of energy are in a slice of pizza that contains 300 food calories. (Food calories are also known as kilocalories.)
300 kcal = _____ joules

On Tuesday, they will be flying to England and will need know how many British Thermal Units (BTU) are equivalent to 100 horsepower hours.
15 horsepower hours = _____ BTU

On Wednesday, they will be back from England feeling very jet-lagged and needing to finish the case of the missing BTU. They will need to know how many BTU it takes to make 10,000 joules.
10,000 joules = _____ BTU

On Thursday, they will be investigating a cafeteria food fight and will need to know how many calories are equivalent to 12 horsepower hours. (Don't ask about the horse in the cafeteria. It's a long story.)
12 horsepower hours = _____ kcal

On Friday, they will be once again looking forward to an uninterrupted weekend and will need to know how many kilowatt hours they can expect from their horse-powered lighting system, which provides up to 5 horsepower hours from a single horse. (The horse powered light is another long story.)
5 horsepower hours = _____kilowatt hours

On Saturday, they will be putting in overtime, solving the case of the missing detectives. They will need to know how many kilowatt hours a million BTU will make.
1,000,000 BTU = _____ kilowatt hours

The Decent Detective Agency's Energy Conversion Tables

To convert from the unit in the first column to the unit in the second column, multiply by the conversion factor in the third column.

To convert:	To:	Multiply by:
BTU	Kilowatt hours	.0002928
BTU	Horsepower hours	.0003931
BTU	Kcal (food calories)	.252
BTU	Joules	1054.8
Horsepower hours	Kilowatt hours	.7457
Horsepower hours	BTU	2547
Horsepower hours	Kcal (food calories)	641.1
Horsepower hours	Joules	2684000
Joules	Kcal (food calories)	.0002389
Joules	BTU	.000948
Kcal (food calories)	Horsepower hours	.00156
Kcal (food calories)	BTU	3.968
Kcal (food calories)	Joules	4186
Kilowatt hours	Horsepower hours	1.341
Kilowatt hours	Joules	3,600,000

Answers:

Monday = 1,255,800 joules
Tuesday = 382.05 BTU
Wednesday = .0948 BTU
Thursday = 7693.2 Kcal
Friday = 3.7285 kilowatt hours
Saturday = 292.8 kilowatt hours

Follow-up questions the teacher or parent may want to ask:

Is a joule a large or small energy unit?
(Think of how many joules it took to equal a serving of cotton candy in our story.)
Answer: small

Could someone really steal joules of energy from a power plant?
Answer: Hmm... not really

What would a person have to do in order to steal joules?
Answer: Convert the joules into potential energy stored in something tangible, such as food or batteries.

How could this be accomplished?
Answer: Maybe they could use the joules from the power plant to recharge a battery that they owned personally. (Would that be stealing?) You could also use the power from the joules to split water molecules into hydrogen gas and oxygen gas, thus making a simple fuel cell. Once outside the power plant, you can let the gases combine again and it they will release energy as they recombine. This is what a fuel cell does. You may be able to think of other creative options!