Metric system of measurement worksheet

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If taking a tour of SI units and prefixes hasn't convinced you of the metric system's advantages, then tackle this exercise: convert 5 miles to inches. Quick. In your head. Even if you remember how many feet are in a mile (5,280) and how many inches are in a foot (12), you still have some complex arithmetic to do. Here's what the math would look like: (5 miles)(5,280 feet/1 mile)(12 inches/1 foot) = 316,800 inches The metric system makes life much easier. A similar conversion would be to find how many centimeters exist in 5 kilometers. A kilometer is 103 meters; a centimeter is 10-2 meters. To make the conversion, you simply move the decimal point to the right five times: 5 kilometers = 5,000 meters = 500,000 centimeters See why SI units are easier? Because of its elegance and simplicity, the International System of Units can be found throughout the world. The United States is the only industrialized nation that still clings to its legacy measures and, as a result, wrestles with a confusing array of unrelated units. Of course, cost factors into why the U.S. has been slow to adopt the metric system. As an example, consider NASA's space shuttle program, which still adheres to the inch-pound system of measurement. NASA engineers recently reported that converting the relevant drawings, software and documentation to SI units would cost a total of $370 million -- a big chunk of change, even for a government agency that easily spends $760 million to get a shuttle into the air [source: Marks]. Of course, not converting comes with its own financial risks. Take NASA again. In 1999, the space agency lost its $125 million Mars Climate Orbiter probe when a unit mismatch caused a malfunction [source: Marks]. The mismatch occurred because its attitude-control system used imperial units, but its navigation software used SI units. As a result, the probe swung too close to the planet, overheated and then ceased to function properly. Now it's a million-dollar piece of space junk, thanks to America's lagging commitment to SI. Many U.S. companies have paid attention to these cautionary tales. John Deere, Proctor & Gamble, Kodak, Ingersoll-Rand and numerous other businesses have converted all or some of their operations to use SI units. That means their overseas factories and supply chains use the same measuring system -- and the same parts -- as their American counterparts. That may seem minor, but the savings can be significant. Cost reductions come from two principal sources: increases in productivity resulting from the use of a decimal-based measurement system and the ability to compete more effectively in global markets. Eventually, the U.S. will make the metric system compulsory for its citizens. When that time comes, it will change the look of road signs, gas pumps and food labels, but it won't affect some hallowed expressions. Why? Because a country kilometer and a 30-centimeter-long hotdog simply don't echo the American experience. Page 2 This bronze statue by Eduardo Paolozzi (1924-2005) was inspired by William Blake's famous image of English mathematician Sir Isaac Newton using a pair of dividers to plot the immensity of the universe. SSPL/Getty Images You may know Sir Isaac Newton (1642-1727) as "that apples-and-gravity guy," but the inscription on his tomb at Westminster Abbey hints at far greater wonders. According to the carved Latin script, interred within are not merely the bones of a great man, but the bones of the greatest man who ever lived. "Mortals rejoice," it reads, "that there has existed such and so great an ornament of the human race!" Even for a eulogy, you have to admit that's a ridiculous level of praise — or so it seems at first. Born the son of an uneducated farmer, Newton died a true polymath — a celebrated master of astronomy, chemistry, mathematics, physics and theology. His endless curiosity led him to tackle problems as minuscule as rug-peeing cats and as grandiose as humanity's ultimate purpose in the cosmos. Newton's many inventions, discoveries and harebrained notions provide a glimpse into a legendary mind. Let's kick things off with a bang. For an apocryphal legend, the tale of Newton and the apple is something of a snoozer — especially when you consider how the man actually thought about the physics of gravity. In laying out his law of universal gravitation, Newton described a mountain so gigantic that its summit poked into space — and that's where he placed the giant cannon. No, Newton didn't plan to fire at alien invaders. His orbital cannon was a mere thought experiment explaining how one object might orbit another. Load too little or too much gunpowder into this theoretical super weapon, and the cannonball will either fall back to Earth's surface or sail off into outer space. Just the right amount of powder, however, and you'd give the cannonball sufficient velocity to fall toward Earth at the same rate that the planet curves away from it. The cannonball, Newton wrote, would continue in free fall all the way around the planet, in effect, orbiting it. First published in 1687, Newton's law of universal gravitation theorized that all particles exert a gravitational force and that gravity — affected by both mass and distance — universally commands the movements of everything from terrestrial rain to planetary orbits. While Einstein would later update some of the details of the Newtonian view, the 16th- and 17th-century physicist laid a solid groundwork for our modern understanding of gravity. An early example of a cat door, though this one has only the one hole, an issue Newton allegedly sought to address. Richard Gillin/Flickr When he wasn't envisioning space cannons and figuring out what holds the universe together, Isaac Newton applied his considerable intellect to other problems — such as ways to keep the cat from scratching on the door. Newton never married and cultivated few friendships, but he did make room in his life for cats and dogs. Sources vary on exactly how this relationship played out. Some contemporary historians label him an animal lover, while other accounts tell doubtful tales regarding a pet dog named Diamond. Some historians even doubt he owned pets at all. The story goes that at the University of Cambridge Newton's experiments were interrupted constantly by his cats scratching at his office door, so he summoned the Cambridge carpenter and had him saw two holes in his door: a large hole for the mother cat and a small one for her kittens. Of course, since the kittens simply followed their mother through the larger hole, the smaller hole remained unused. "Whether this account be true or false, indisputably true is that there are in the door to this day two plugged holes of proper dimensions for the respective egresses of cat and kitten," wrote a Newton contemporary some years after the scientist's death. The jury is still out on this story. Newton could have invented one of the world's most popular cat accessories — or somebody at Cambridge just liked to drill random holes. Designed by Salvador Dali, this bronze statue depicts a surreal Isaac Newton holding a sphere that represents the center of the universe. Mundofoto/Shutterstock While some historians doubt the tales of Newton's household pets, there's no denying his impact on our modern understanding of physics. Just as he nailed the fundamental workings of gravity in his law of universal gravitation, so too did he cut to the core of motion itself in his three laws of motion in 1687. Here's how they all break down: An object will remain at rest or moving in a straight line unless acted upon by an external force.When force is applied to an object, it will accelerate (force = mass x acceleration).For every action, there is an equal and opposite reaction. It's easy to take these three laws for granted, yet scholars wrestled with the fundamental concepts of motion for centuries. The Greek philosopher Aristotle thought smoke moved upward because smoke was mostly air, and therefore was consciously deciding to go into the sky to hang out with the rest of its air buddies. French philosopher René Descartes devised laws of motion that were very similar to parts of Newton's first and third laws, but he still identified God as the prime mover. Beautiful in their simplicity, Newton's three laws enable scientists to understand the movement of everything from subatomic particles to spiraling galaxies. This 1634 painting by David Ryckaert III depicts an alchemist at work. Imagno/Hulton Archive/Getty Images Newton's ravenous hunger for knowledge led him to numerous scientific discoveries, but they also led him on at least one winding goat ride to nowhere: the quest for alchemy's legendary philosopher's stone. Descriptions of the stone vary from text to text, but it was essentially a man-made stone or elixir capable of bestowing universal transmutation. It could turn lead into gold, cure illnesses and even transform a headless cow into a swarm of bees. Why did one of the greatest scientific icons involve himself with alchemy? To answer that question, you have to remember that the scientific revolution was just gaining steam in the 1600s. Alchemy hadn't quite been kicked to the curb as outdated quackery, and for all their occultism and mystical philosophy, alchemical texts also dabbled in very real chemistry. Thirty years' worth of experimental notebooks, however, reveal that Newton's sights were set on far more than chemical reactions or even the promise of gold. According to historian William Newman, he sought "limitless power over nature." This led Newton to texts on the philosopher's stone, which he attempted to decode in order to produce the mysterious substance itself. Ultimately a fruitless effort, Newton managed to produce a purple copper alloy. While not quite an invention, the stone illustrates much about the mind and times of this scientific icon. In 2005, historian Newman reproduced this same stone by following Newton's 300-year-old notes. No transmutations were reported. Newton drops some math knowledge. Hulton Archive/Getty Images Whether your high school calculus class blew your mind or crushed your spirit, you can blame it all on Isaac Newton. See, mathematics is the system by which we gauge the interworking of the cosmos, but like many scientists of his age, Newton found that existing algebra and geometry simply weren't sufficient for his scientific needs. Let that sink in for a moment: Existing math wasn't advanced enough for Newton. Mathematicians of the day could calculate the speed of a ship, but they couldn't figure out the rate at which the ship was accelerating. They could measure the angle of a sailing cannonball, but they had no way of calculating which angle would send the cannonball the farthest. What they needed was a mathematical means to calculate problems that involved changing variables. This was the problem facing Newton when an outbreak of bubonic plague hit England in spring of 1665. As plague-stricken citizens dropped dead in the streets, Cambridge closed up shop, and Newton spent 18 months formulating the origins of what he called "the science of fluxions." Today we know it as calculus, a critical tool for physicists, economists and probability scientists. In the 1960s, it even enabled Apollo engineers to chart a course from Earth to the moon. Of course, Newton can't take all the credit. He typically shares the accomplishment with German mathematician Gottfried Leibniz, who independently developed calculus around the same time. Newton disperses light with a glass prism. Apic/Hulton Archive/Getty Images What's that, rainbows? You thought your secrets were safe from Isaac Newton? Guess again, because in 1704, he literally wrote the book on the refraction of light. Jazzily titled "Opticks," the work changed the way we think about light and color. Scientists of the day knew that rainbows formed when light was refracted and reflected in raindrops, but they didn't know why rainbows were so colorful. When Newton first began his studies at Cambridge, the common theory was that the water somehow dyed the sun's rays different colors. Using a lamp and a prism, Newton experimented by running white light through a prism to separate it into a rainbow of colors. The prism trick was nothing new, but scientists assumed the prism colored the light. By reflecting the scattered beams into another prism, however, Newton reformed them back into white light, proving that the colors were a characteristic of the light itself. So eat it, rainbows. Newton saw right through you, and he used the knowledge to create the next invention on our list. These replicas are of telescopes invented by Galileo in 1609 and Sir Isaac Newton in 1668. Newton's telescope (left) uses a concave mirror to gather light instead of a simple lens which produces false color due to the dispersion of light. SSPL/Getty Images Newton was born into an age of lackluster telescopes. Even the better models used a set of glass lenses to magnify an image. Through his experiments with colors, Newton knew the lenses refracted different colors at different angles, creating a fuzzy image for the viewer. As an improvement, Newton proposed the use of reflecting mirrors rather than refracting lenses. A large mirror would capture the image, then a smaller mirror would bounce it into the viewer's eye. Not only does this method produce a clearer image, it also allows for a much smaller telescope. Granted, a Scottish mathematician proposed the idea of a reflecting telescope first, but Newton was the guy who actually mustered the energy to build one. Grinding the mirrors himself, Newton assembled a prototype and presented it to the Royal Society in 1670. Merely 6 inches (15 centimeters) long, the device eliminated color refraction and boasted 40x magnification. To this day, nearly all astronomical observatories use a variant of Newton's original design. Coins being stamped out and weighed to see that they contain the correct amount of metal. Debasement of coinage by clipping was a problem until the introduction of coins with milled (patterned) edges. Ann Ronan Pictures/Print Collector/Getty Images At this point, you probably have a good sense of Newton's obsessive nature. So it should come as no surprise to learn that, when appointed the largely ceremonial role of Warden at the Royal Mint in 1696, the famed inventor took to the mean streets of London — in disguise — to root out counterfeiters. Yep, Isaac Newton was essentially a 17th-century Batman. And since counterfeiting was then a capital offense in Britain, the miscreants he brought to justice typically wound up at the execution block. See, by the late 1600s, England's financial system was in full-blown crisis mode. The country's currency consisted entirely of silver coins, and that silver was often worth more than the value stamped on it. So what did people do? Why, they melted down the coins or "clipped" silver from the edges to sell to France. By Newton's time, clipping had done a number on the nation's currency. The average bag of English coins was just a hodgepodge of damaged and unrecognizable silver chunks. As such, forgers had a field day. Since English coins varied so widely in size and quality, it was easy to pass off even the most sloppy knockoffs as legal tender. Riots broke out as faith in the English currency plummeted. So in 1696, the British government called on Newton. In addition to hands-on crime fighting, he recalled all English coins and had them melted down and remade into a higher-quality, harder-to-counterfeit design. It was a bold move, considering that the entire country had to make do without a currency for an entire year. Working as many as 18 hours a day, Newton reorganized the Royal Mints into high-quality, high-efficiency factories pumping out currency that was highly resistant to forgers. You know those ridges on the edge of a U.S. quarter? Those are milled edges, a feature introduced by Newton on English coins to prevent clipping. Newton never experienced the wonders of Chinese steamed buns, but he did outline the math behind what's happening here. Gil Asakawa/The Denver Post/Getty Images As you've probably gathered, Isaac Newton's idea of stone-cold chilling involved tackling a scientific or even occultist problem with the full power of his considerable intellect. Where existing instruments, methods and laws failed him, he invented new ones. You could say he was the Chuck Norris of scientists. If you've ever returned to a half-finished cup of coffee and found it cold, then you've experienced cooling. Newton, however, was interested in the physics of that cooling cup. So in the late 1700s, he conducted experiments involving red-hot iron balls. He noted that when the difference in temperature between the ball and the surrounding air was less than 50 degrees Fahrenheit (10 degrees Celsius), the rate of heat loss was proportional to the temperature difference. Thus, Newton's law of cooling states that the rate of heat loss of a body is proportional to the difference in temperatures between the body and its surroundings. French chemist Pierre Dulong and physicist Alexis Petit later tweaked the law in 1817, but the groundwork of Newton's work on cooling underlies everything from nuclear reactor safety to space exploration. A vision of the apocalypse, which Newton saw happening in 2060. joshimerbin/Shutterstock Humans have always worried about the end of the world, but Isaac Newton wasn't the type of man to accept an apocalypse scare at face value. No, when fearmongers of the 1700s made biblical predictions about the end of times, he hit the books and did some fact-checking. Newton was no slouch when it came to theology. Just as his obsessive, problem-solving nature led him to explore the mysteries of alchemy, so too did he venture into the riddles of biblical visions, such as those described in the cryptic Book of Daniel. Newton believed wholeheartedly that the Bible contained an ancient and irrefutable wisdom, if only learned men could crack its codes. Still, 300-year-old documents indicate that his primary motivation in studying the Book of Daniel was to silence the fearmongers. His projected date for the end of the world? The year 2060 — possibly later, but absolutely no sooner. In other words, "Move along, folks, nothing to see here." Or at least that's what he told his fellow denizens of the 18th century. You, on the other hand, might think differently on the matter. Originally Published: Jan 12, 2011

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