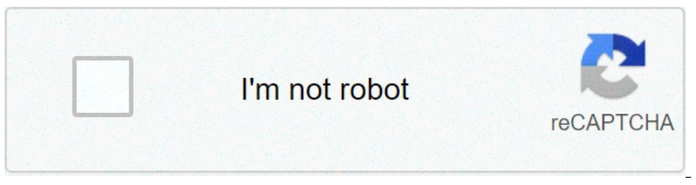

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Circular motion into linear motion

Photo: FlickrThe circular saw was invented in England at the turn of the nineteenth century, though there is considerable disagreement on precisely when and by whom the tool was devised. Whenever and wherever it happened, the innovation was a great step forward. Among many advantages of the circular saw is its simple efficiency. Unlike the reciprocating saw, which cuts only half the time (each cutting stroke is followed by a return stroke), the circular saw is ready to cut whenever its blade is in motion.With the possible exception of the electric drill, the hand-held circular saw is the power tool most often found in the average homeowner's tool chest. It is easy to use, affordable, and astonishingly flexible and practical. The portable circular saw has other names, too, including the Skilsaw (a proprietary trade name) and electric handsaw.The portable circular saw is designed to cut lumber and boards to size. Various models require different-sized blades, among them blade diameters of six and a half inches and eight and a quarter inches; the most popular by far, however, are the seven-and-a-quarter- inch models.Most portable circular saws have electric motors with two or more horsepower that turn the blade at about five thousand revolutions per minute; capacities and revolutions per minute vary from model to model. The motor is protected in a housing, the blade by a fixed guard on top and a retractable guard below. There is a handle on top, and a sole plate or shoe on the bottom. Some models come with an adjustable T-guide.A typical circular saw weighs between nine and twelve pounds. Most contemporary models feature insulated, rigid plastic casings, with steel soles and guards.The vertical angle of cut can be adjusted from its standard ninety degrees to forty-five degrees, or to any angle in between. The depth of cut can be adjusted, too. A typical seven-and-a-quarter-inch circular saw will cut to a depth of two-and-a-quarter inches at 90 degrees. At a forty-five-degree angle, the saw will cut through a two- by-four on one pass, a thickness of one and a half inches.These saws can also be fitted with masonry or other specialty blades for cutting other materials. Blades with a wide range of teeth configurations for cutting wood are also available, though a combination blade, which crosscuts and rips, may suffice for most or all of your needs.In addition to the common seven-and-a-quarter-inch saw, other sizes are available. On one extreme, there's a three-and-three- eighths-inch saw that uses a rechargeable battery. This saw is expensive, however, and has significant built-in limitations. For example, its depth of cut is only eleven-sixteenths of an inch when sawing a forty-five-degree bevel. And the saw runs out of power pretty quickly (ripping four lengths of half-inch plywood is the present maximum per charge). For some applications, however, the convenience and light weight of this little saw may make it very handy. At the other end of the spectrum, there are giant models designed to be used by timber framers, but they are unwieldy and of little use to most woodworkers.Worm-Drive Circular Saw One heavy-duty variety of the portable circular saw is the worm-drive saw. Most circular saws are direct-drive, meaning that the shaft to which the blade is attached is part of the electric motor's rotor. In a worm-drive saw, however, the motor drives the blade from the rear.The worm-drive mechanism that connects the motor to the saw arbor or shaft consists of two gears. One is cylindrical in shape and threaded like a screw. This is the "worm gear" attached to the armature of the motor, which in turn drives a wheel-shaped gear called the worm wheel. The worm wheel is attached directly to the arbor shaft onto which the saw blade is fastened.The advantage of the worm-drive saw is that it delivers the high revolutions of the engine to the saw blade at a much reduced rate of speed. This means that the torque (rotational force) is much greater, making tasks like cutting double thicknesses of dimensional lumber or several sheets of plywood much easier. The saw just keeps on cutting without the complaints or stalling you would get from most sidewinder (that is, traditional configuration) circular saws under such circumstances. When forced, a worm-drive saw is much less likely to kick back than a sidewinder saw.Many experienced framing carpenters prefer worm-drive saws. The worm-drives are heavier (some weigh twice as much as direct- drive models) but the added power more than compensates. They are a bit more convenient for right-handers because the blade is to the left of the motor, and you can see the cutting edge without leaning over the saw.A worm-drive circular saw is not an appropriate tool for the occasional user, not least because it is significantly more expensive than sidewinder saws. But it's a real workhorse designed for long, hard use. So, for building that big barn you've been thinking about… it just might be the answer.Sliding Circular Saws This is something of a catchall term, but one I find convenient to describe several different saws that are of related design. The classic Delta sawbuck belongs here, as do the new breed of chop boxes called sliding or "pull-through" miter saws.The hinged blade assembly on a sliding saw swings down like a paper cutter. What distinguishes it from the miter saw from which it evolved is that a pair of rods also allows it to be drawn toward the operator. This sliding action means you can cut wider stock than with a stand miter saw (some models will cut twelve-inch widths). Most models also tilt and turn, allowing miter and bevel cuts. Saws of the sawbuck school don't swing down, but do slide, tilt, and turn.These tools are more versatile than the basic miter saw; on the other hand, they don't offer all the options of a radial-arm saw. But for those woodworkers who do a minimum of ripping and don't need to make moldings or do sanding jobs on the cutoff saw, a sliding circular saw may be an economical and portable option. These saws can be stored and moved easily and require a minimum of alignment. WHAT IS "HOW STUFF MOVES"? Mechanics is the study of how things move. It was the first quantitative science to achieve wide power to predict behavior, including things never before directly observed. Newton, Leibniz, and others invented calculus to describe motion and we will find both differential and integral calculus extremely useful throughout this course. This is the first in a 3-part series of courses that parallels the second-semester mechanics course taught at Harvey Mudd College. Part 1 explores the concepts of momentum, force, and energy, and how these properties define the motion of objects at everyday speeds. Part 2 examines angular motion, and Part 3 examines wave motion. This course is an invitation to develop your problem-solving skills and to learn how to apply mathematics to all sorts of problems of the physical world. Learning the rules that govern how stuff moves in the world around us is exciting; using those rules to predict _correctly _something that you haven't observed means that you really understand something. It's a great feeling. WHAT SHOULD I KNOW BEFORE WE START? You need not have taken physics before, but we assume that you have studied mathematics, up to and including a first course in calculus. You may be taking a calculus course concurrently with this course; that should be a good strategy. We will introduce important calculus ideas and methods as the need arises and provide examples. There is a Mathematics Diagnostic Test that you can take at the beginning of this course to ensure that your mathematics background will set you up for success in this course.The basic physics of how objects move The concepts of momentum, force, and energy How these properties define the motion of objects at everyday speeds Harvey Mudd CollegeReceive an instructor-signed certificate with the institution's logo to verify your achievement and increase your job prospectsAdd the certificate to your CV or resume, or post it directly on LinkedInGive yourself an additional incentive to complete the courseedX, a non-profit, relies on verified certificates to help fund free education for everyone globally Skip to main content Steve Debenport/E+/Getty Images A linear foot is the same measurement as a foot. The linear foot measures 12 inches in length. Linear is used to describe the total length of an item without regard to width or thickness. Simply measuring items by the standard 12 inch foot is the same measurement. Linear means a straight line, and indicates attention to the length dimension only. Lumber sold by the linear foot simply indicates the length of the boards placed end-to-end, no matter how wide or thick they are. Similarly, a bolt of cloth is sold by the linear foot, regardless of the width of the fabric. Betsie Van der Meer/The Image Bank/Getty Images A linear pattern exists if the points that make it up form a straight line. In mathematics, a linear pattern has the same difference between terms. The patterns replicate on either side of a straight line. An example is a line of the form y = mx + c, with (x, y) coordinates (1, 5), (2, 7) and (3, 9). In the example, the difference between the x coordinates of any two consecutive terms is 1, as given by 2 - 1 or 3 - 2. Similarly, the difference in the y coordinates is 2 (7 - 2 or 9 - 7). Based on observation, it's possible to predict any other possible coordinates of the linear pattern. For example, the next coordinates after (3, 9) are (3 + 1, 9 + 2) or (4, 11). It's also possible to identify a mathematical relationship between the x and y coordinates of a linear equation with points (1, 2), (2, 4) and (3, 6). If x = 1, y =2 and x =2, y = 4, then y is twice x, which is represented algebraically as y = 2x. Similar patterns are spotted in weaving, beading paper and music that has a linear beat. Stripes on clothing, footprints and zippers show linear patterns as well. The passage of the day and seasonal changes exhibit repetition that's consistent with linearity. Erik Isakson/Getty Images Linear sequences are simple series of numbers that change by the same amount at each interval. The simplest linear sequence is one where each number increases by one each time: 0, 1, 2, 3, 4 and so on. Linear sequences are the most basic type of sequence. Learning to detect and predict sequences is useful in pattern recognition, both by visual inspection and technological algorithms. To determine if a series of numbers is a linear sequence, subtract each number by the number before it. If the result is always the same, it confirms that the pattern is a linear sequence.