Perpendicular slope rule

When lines intersect, angles created by an intersection can be valuable information about the conditions surrounding the intersection. Probably the most popular intersection angle is the 90º angle, which creates perpendicular lines. Let's continue our line study by examining perpendicular lines. Perpendicular lines are two coplanar lines that intersect at right angles (90º). We know that there is a relationship between the slopes of parallel lines (slope is equal). There is also a link between the slopes of perpendicular lines (slopes are negative reciprocities) No vertical perpendicular lines have negative reciprocal inclinations! (The product of the slopes is -1.) Why did we specify no vertical perpendicular lines? On the coordinate plane, all vertical lines are parallel to the y-axis, and all horizontal lines are parallel to the x-axis. These vertical and horizontal lines are perpendicular to each other. But expressing their slopes as negative reciprocity is not mathematically possible. The slope of vertical lines is undefined, and the negative inverse of the horizontal line (slope 0) is also undefined. Perpendicular lines are indicated by a field to indicate the position of the correct angle. Perpendicular lines intersect in one place, which becomes the vertex of the correct angle. Remember that the right angle contains 90º (think of the angle in the corner of the square). To find negative reciprocity of a number, invert the number (invert or reverse) and renegotiation the value. Number: Negative reciprocity: 3 (3 is 3 above 1) Line equations: y = 2x + 1 These lines are perpendicular because their inclination is reverse. Negative reciprocity 2 is . If you multiply the slope of times its negative inverse, the result is always -1. Slope criteria for perpendicular lines: Let's prove that perpendicular lines have negative reciprocal inclination, and negative reciprocal inclination implies perpendicular lines. We take a look at Geometric/Algebraic Proof and Transformative Proof. Geometric/Algebraic Proof: If two lines are perpendicular, the slope is reverse. (Slope product = -1.) Vertical lines will not be considered because their inclination is undefined. In addition, horizontal lines will not be taken into account because their slopes 0 have unspecified reciprocity. Vertical and horizontal lines are perpendicular. To make the calculation easier, translate the perpendicular lines so that the intersection is the beginning. Draw a vertical line x =1 to create ΔABC. In this proof we will use the Distance Formula and Theorca Pythagorean. Justification 1. with vertical line x = 1 1. Considering 2. The vertical line x = 1 intersects in (1, m1) and at (1, m2). 2. The horizontal distance, run, is 1 for rise/run (slope) in each rectangular triangle, so the increase distances) will be m1 and m2. 3. ∠ABC is right angle. 3. Perpendicular lines form angles at right angles. 4. ΔABC is a rectangular triangle. 4. The rectangular triangle contains one right angle. 5. 5. Apply a distance formula. 6. 6. Use pythagorean in right ΔABC. 7. 7. Apply square square root to get radicand. 8. 8. Expand and combine similar terms. 9. 9. Lower m12 + m22 from both sides of the equation. 10. 10. Division by -2. (Shows pervert product = -1) 11. 11. Division by m2. As we try to establish a connection between perpendicular lines and negative cross slopes, we will also have to prove what the above says. In this way, we will combine perpendicular lines with negative reciprocal inclination and negative reciprocal inclination with perpendicular lines. If the slope of two lines is negative inverses, the lines are perpendicular. To make the calculation easier, translate the lines so that the intersection is the beginning. Draw a vertical line x = 1 to create ΔABC. We will use the Distance Formula to express the sides of ΔABC, and then we will try to show ΔABC as a rectangular triangle (making the lines perpendicular). Justification 1. vertical line x = 1 1. Considering 2. The vertical line intersects 2. The horizontal distance,run, is 1 for rise-run in each rectangular triangle, so the increase (vertical distances) will be m1 and m2. 3. 3. Apply a distance formula. Will the sides of the big triangle satisfy the PiAras theor? 4. 4. Use the Pythagorean Orocracker in ΔABC. 5. 5. Use square square root to get radicand. 6. 6. Expand and combine similar terms. 7. 7. Lower m12 + m22 from both sides of the equation. 8. 8. Division by -2. 9. 9. Division by m2. (This is a Given statement that is TRUE. Pythagorean Thm is pleased.) 10. ΔABC is a rectangular triangle. 10. The sides of ΔABC meet the Pythagorean theorem. 11. ∠ABC is right angle. 11. The rectangular triangle has 1 right angle. 12. 12. Perpendicular lines create angles at right angles. If the two lines are perpendicular, the slope is negative inverses. (Slope product = -1.) Vertical lines will not be considered because their inclination is undefined. In addition, horizontal lines will not be taken into account because their slopes 0 have unspecified reciprocity. Vertical and horizontal lines are perpendicular. We used 90º rotation to make this proof. • For visualizations, a unit circle is drawn (centered to O, radius 1), intersecting p-line at R point and line q at point D. (any circle centered to O can be used to visualize rotation) • Rotate the R 90° point counterclockwise relative to the center of rotation O. Because p and q are perpendicular, the image (point D) will lie on the q-line at that 90º counterclockwise rotation. • Because this rotation maps the positive X axis to the positive y-axis to negative x-axis, we know that the coordinates R(a,b) are converted to coordinates D(-b,a). Graphically you can see the movement of lengths a and b under rotation. • Study height and run, m1 (slope p) is, and m2 (slope q) is . • The slope of line q is the negative inverse of the slope of the p-line. As was the case in Geometric/Algebraic Proof, we also need to prove the opposite of this thesis. In this way, we will combine perpendicular lines with negative reciprocal inclination and negative reciprocal inclination with perpendicular lines. If the slope of two lines is negative inverses, the lines are perpendicular. Vertical lines will not be considered because their inclination is undefined. In addition, horizontal lines will not be taken into account because their slopes 0 have unspecified reciprocity. Vertical and horizontal lines are perpendicular. We will examine the line t, which is perpendicular to p at point O and showing that the line t must actually be line q. • If m1 = -1/m2, we know that one of the slopes is positive and one slope negative. Lines p and q meet at one point, O. • There is a line, t, by O, which is perpendicular to the p line. • From our previous evidence, we know that the slope of the p line will be a negative inverse of the t-slope. If we allow mt = slope t, we know m1 = -1/mt • By replacing we have: -1/m2 = -1/mt . And now we know m2 = mt . • Because the t line and the q line have the same slope and pass through the same point, they are the same line (t = q). • Since p is perpendicular to t, we know p is perpendicular to q. (Remember from working with structures that point on the line (O to p), one and only one perpendicular, q, can be drawn.) NOTE: Republishing material (in whole or in part) from this site on the Internet is a copyright infringement and is not considered fair use for teachers. Please read the Terms of Use. To continue to enjoy our site, please confirm your identity as a human being. Thank you very much for your cooperation. If you see this message, it means that we are having trouble loading external resources on our website. If you're behind an internet filter, make sure *.kastatic.org and *.kasandbox.org are unlocked. If you see this message, it means that we are having trouble loading external resources on our website. If you're behind an internet filter, make sure *.kastatic.org and *.kasandbox.org are unlocked. If two non-vertical lines that are on the same plane have the same slope, they are said to be parallel. Two parallel lines never intersect. If two non-vertical lines in the same plane intersect at right angles, they are said to be perpendicular. The horizontal and vertical lines are perpendicular to each other, i.e. the Example perpendicular line slope of red line: $$m_{1}=\frac{-3-2}{2-\left (-3 \right)}=\frac{-5}{5}=-1$$ Slope blue line $$m_{2}=\frac{2-\left (-2 \right)}{3-\left (-1 \right)}=\frac{4}{4}=1$$ The slope of two perpendicular lines is reverse. The product of the perpendicular slope is -1 from $$m\cdot -\frac{1}{m}=-1,\: \: where\: \: m_{1}=m\: \: \: and\: \: m_{2}=--frac{1}{m}$$ Video lesson Are the two lines parallel? How to use Algebra to find parallel and perpendicular lines. Parallel lines How do we know when two lines are parallel? Their slopes are the same! The slope is the value m in the line equation: y = mx + b Example: Find the equation of the line, which is: parallel to y = 2x + 1 and passes although point (5,4) Slope y = 2x + 1 is: 2 Parallel line must have the same slope 2. We can solve it using the point-slope equation of the line: y − y1 = 2(x − x1) And then place at point (5,4): y − 4 = 2(x − 5) And this answer is OK, but let's also put it in y = mx + b form: y − 4 = 2x − 10 y = 2x − 6 Vertical Lines But it does not work for vertical lines ... I explain why at the end. Not the same line Be careful! They can be the same line (but with a different equation), so they are not parallel. How do we know if they are really the same line? Check their y-intersections (where they intersect the y-axis) and their slope: For y = 3x + 2: the slope is 3, and y-intercept is 2 For y − 2 = 3x: the slope is 3 and the intersection is 2 In fact, they are the same lines, so there are parallel perpendicular lines Two lines are perpendicular when they meet at right angles (90°). To find a perpendicular slope: When one line has a slope of m, the perpendicular line has a slope of −1m In other words, a negative reverse example: Find the equation of the line perpendicular to y = −4x + 10 and passes though point (7,2) Slope y=−4x+10 is: −4 negative inverse this slope is: m = −1−4 = 14 So the perpendicular line will have a slope of 1/4: y − y1 = (1/4)(x − x1) And now place at point (7.2): y − 2 = (1/4)(x − 7) And this answer is OK, but let's also put it in the form of y=mx+b: y − 2 = x/4 − 7/4 y = x/4 + 1/4 A quick check of the perpendicular multiplication of the slope m by its perpendicular slope −1m we get just −1. So, to quickly see if the two lines are perpendicular: When we multiply their slopes, we get −1 Yes: Are these two lines perpendicular? Line slope = 2x + 1 2 y = −0.5x + 4 −0.5 After multiplying the two slopes we get: 2 × (−0.5) = −1 Yes, we have −1, so they are perpendicular. Vertical lines Previous methods work nicely except for the vertical line: In this case, the gradient is indeterminate (because we cannot divide by 0): m = yA − yBxA − xB = 4 − 12 − 2 = 30 = undefined So just rely fact that: the vertical line is parallel to another vertical line. the vertical line is perpendicular to the horizontal line (and vice versa). Summary of parallel lines: same lines perpendicular slope: negative reciprocal slope (−1/m)

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