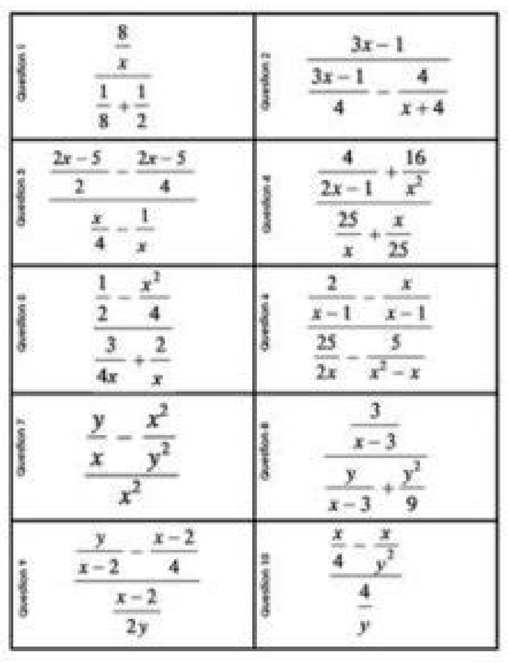
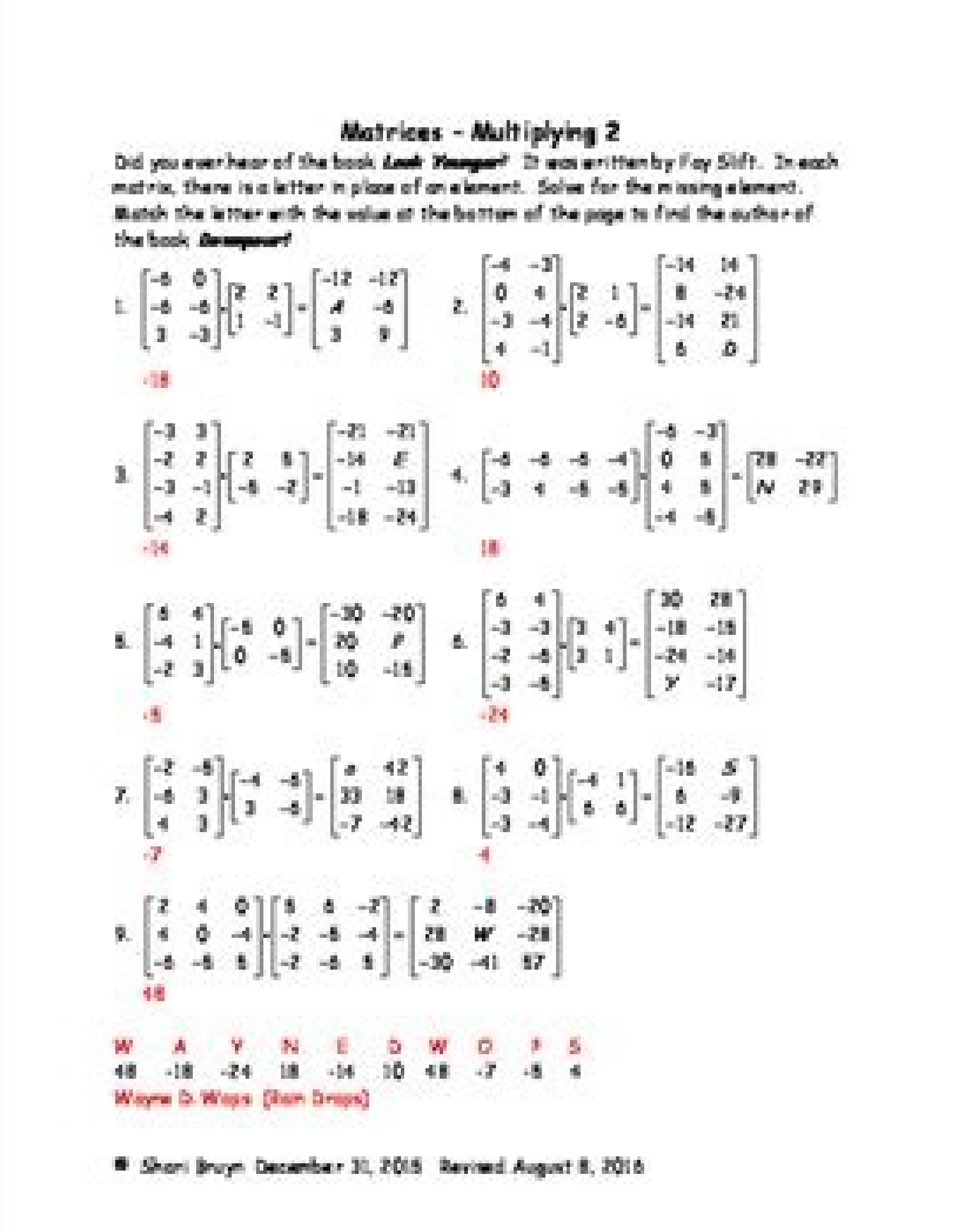
Matrix inverses and determinants worksheet answers





(Imagine in our bus and train example that the prices on the train were all exactly 50% higher than the bus: so now we can't figure out any differences between adults and children. and someone asks "How do I share 10 apples with 2 people?" But we can take the reciprocal of 2 (which is 0.5), so we answer: 10 × 0.5 = 5 They get 5 apples each. Note: ad−bc is called the determinant. The Identity Matrix can be 2×2 in size, or 3×3, 4×4, etc ... AB is almost never equal to BA. Definition Here is the definition: The inverse of A is A-1 only when: AA-1 = A-1A = I Sometimes there is no inverse at all. See if you also get the Identity Matrix: Why Do We Need an Inverse? A Real Life Example: Bus and Train A group took a trip on a bus, at $3 per child and $3.20 per adult for a total of $118.40. It is also a way to solve Systems of Linear Equations. This is what it looks like as AX = B: = It looks so neat! I think I prefer it like this. With matrices the order of multiplication usually changes the answer. It can be done that way, but we must be careful how we set it up. Also note how the rows and columns are swapped over ("Transposed") compared to the previous example. ... Because with matrices we don't divide! Seriously, there is no concept of dividing by a matrix. There needs to be something to set them apart.) Bigger Matrices The inverse of a 2x2 is easy ... a matrix has an inverse : Inverse of a MatrixWe write A-1 instead of 1A because we don't divide by a matrix! And there are other similarities: When we multiply a number by its reciprocal we get 1: 8 × 18 = 1 When we multiply a matrix by its inverse we get the Identity Matrix (which is like "1" for matrices): A × A-1 = I Same thing when the inverse comes first: 18 × 8 = 1 A-1 × A = I Identity Matrix We just mentioned the "Identity Matrix". For those larger matrices there are three main methods to work out the inverse: Conclusion The inverse of A is A-1 only when AA-1 = A-1A = I To find the inverse of a 2x2 matrix: swap the positions of a and d, put negatives in front of b and c, and divide everything by the determinant (ad-bc). Order is Important Say that we are trying to find "X" in this case: AX = B This is different to the example above! X is now after A. It is the matrix equivalent of the number "1": I = A 3x3 Identity Matrix It is "square" (has same number of rows as columns), It has 1s on the diagonal and 0s everywhere else. And the determinant 24−24 lets us know this fact. Do not assume that AB = BA, it is almost never true. Now we can solve using: X = A-1B = = −9×118.4 + 8×135.2 8.75×118.4 − 7.5×135.2 Same answer: 16 children and 22 adults. And it makes sense ... To solve it we need the inverse of "A": −1 = 13×3.6−3.2×3.5 It is like the inverse we got before, but Transposed (rows and columns swapped over). Let us try an example: −1 = 14×6−7×2 How do we know this is the right answer? Well, for a 2x2 matrix the inverse is: −1 = 1ad−bc In other words: swap the positions of a and d, put negatives in front of b and c, and divide everything by ad−bc . But we can multiply by an inverse, which achieves the same thing. The same thing can be done with matrices: Say we want to find matrix X, and we know matrix A and B: XA = B It would be nice to divide both sides by A (to get X=B/A), but remember we can't divide. But what if we multiply both sides by A-1 ? So matrices are powerful things, but they do need to be set up correctly! The Inverse May Not Exist First of all, to have an inverse the matrix must be "square" (same number of rows and columns). How many children, and how many adults? That equals 0, and 1/0 is undefined. Just like a number has a reciprocal ... First, let us set up the matrices (be careful to get the rows and columns correct!): This is just like the example above: XA = B So to solve it we need the inverse of "A": −1 = 13×3.6−3.5×3.2 Now we have the inverse we can solve using: X = BA-1 = = 118.4×−9 + 135.2×8118.4×8.75 + 135.2×−7.5 There were 16 children and 22 adults! The answer almost appears like magic. So how do we solve this one? It should also be true that: A-1A = I Why don't you have a go at multiplying these? Sometimes there is no inverse at all Copyright © 2020 MathsIsFun.com They took the train back at $3.50 per child and $3.60 per adult for a total of $135.20. (Note: writing AA-1 means A times A-1) 2x2 Matrix OK, how do we calculate the inverse? But also the determinant cannot be zero (or we end up dividing by zero). XAA-1 = BA-1 And we know that AA-1 = I, so: XI = BA-1 We can remove I (for the same reason we can remove "1" from 1x = ab for numbers): X = BA-1 And we have our answer (assuming we can calculate A-1) In that example we were very careful to get the multiplications correct, because with matrices the order of multiplication matters. Reciprocal of a Number (note: 18 can also be written 8-1)... look at the numbers: the second row is just double the first row, and does not add any new information. Such a matrix is called "Singular",which only happens when the determinant is zero. We cannot go any further! This matrix has no Inverse. Calculations like that (but using much larger matrices) help Engineers design buildings, are used in video games and computer animations to make things look 3-dimensional, and many other places. How about this: −1 = 13×8−4×6 24−24? Please read our Introduction to Matrices first. Remember it must be true that: AA-1 = I So, let us check to see what happens when we multiply the matrix by its inverse: = 4×0.6+7×−0.24×−0.7+7×0.4 2×0.6+6×−0.22×−0.7+6×0.4 = 2.4−1.4−2.8+2.8 1.2−1.2−1.4+2.4 And, hey!, we end up with the Identity Matrix! So it must be right. The calculations are done by computer, but the people must understand the formulas. Using the same method, but put A-1 in front: A-1AX = A-1B And we know that A-1A= I, so: IX = A-1B We can remove I: X = A-1B And we have our answer (assuming we can calculate A-1) Why don't we try our bus and train example, but with the data set up that way around. compared to larger matrices (such as a 3x3, 4x4, etc). What is the Inverse of a Matrix? Its symbol is the capital letter I. But it is based on good mathematics.

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