HOW EXCEL CAN HELP YOU SOLVE PHYSICAL PROBLEMS

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MS Excel is a very useful tool for engineering calculations. Students usually use it to prepare laboratory reports. Hence, students know at least the basic functions of MS Excel. Additionally, MS Excel is widely available thanks to educational licenses.

The standard procedure students use to solve the physical problems is as follows… They use physical laws and transformations of formulas (mathematical knowledge and competencies are essential). Finally, they derive the formula for the required physical parameters. The last step is to check that the derived formula makes physical sense.

I want to suggest changing this standard procedure sometimes… Instead of transforming formulas, numerical calculations should be used. But the calculation (typical of numerical procedures) of the final value of the parameter being sought is not sufficient. The physical problem is fully solved when we know the analytical formula for how the required parameter varies with the conditions… Using MS Excel, we can not only calculate the final parameter but also derive the analytical formula for the searched parameters.

MS Excel can help solve some physical problems that lead to integration or differential equations. We know that integration is nothing more than summing up. MS Excel is good at summing cell contents. We also know that differential equations can be solved step by step [1]. It leads to the discretisation of differential equations.

I will present one example of a physical problem to solve: How to find the formula for electrostatic force $F(x)$ between a point charge $-q$ and a homogeneously charged with charge $+Q$ stick (see Figure)? This problem can be solved analytically, so the results of numerical investigations are easy to verify…

In this example, we also use a special tool implemented in MS Excel: Solver. It is a tool for multi-parameter optimisation and can help find parameter values that satisfy the problem assumptions.

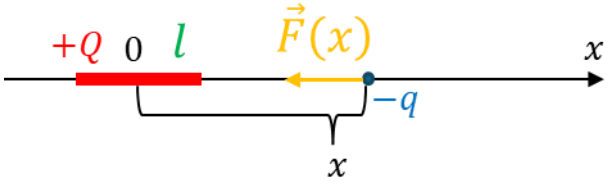

Figure. Homogenously charged $(+Q)$ stick with length l. Distance between the point charge $(-q)$ and the centre of the stick is x.

[1] Paweł Perkowski (2022). Zastosowanie arkusza kalkulacyjnego w rozwiązywaniu prostych zagadnień z dynamiki. Youtube film prepared for the Festival of Science in Warsaw. https://www.youtube.com/watch?v=l9FQ46shsIw&t=334s