Homework 1 in Optimization in Enginieering

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Exercise 1. (Knapsack Problem) The following 8 objects with the given weights and profits are available for delivery.

Object	1	2	3	4	5	6	7	8
Weight (kg)	153	54	191	66	239	137	148	249
Profit (€)	232	73	201	50	141	79	48	38
Profit density (€/kg)	1.52	1.35	1.05	0.76	0.59	0.58	0.32	0.15

The "Knapsack" (for example a trailer, vehicle, container or a rocket), in which the objects should be transported, has a weight limitation of **645 kg**. There is no space limitation. Formulate the optimization problem which maximizes the profit of the delivery without exceeding the weight limitation. Note that objects can't be partially transported and each object is available as often as needed.

Exercise 2. (Cargo Optimization) An airfreight has three compartments for storing cargo: front, centre and rear. These compartments have the following limits on both weight and space:

Compartment	Weight capacity (tonnes)	Space capacity (m^3)
Front	10	6800
Centre	16	8700
Rear	8	5300

Furthermore, the weight of the cargo in the respective compartments must satisfy the proportion **10:16:8** as in their weight limits to maintain the balance of the plane.

The following four cargoes are available for shipment on the next flight.

Cargo	Weight (tonnes)	Volume (m^3/ton)	Profit (€/ton)
C1	18	480	310
C2	15	650	380
C3	23	580	350
C4	12	390	285

Any proportion of these cargoes can be accepted. The objective is to determine how much (if any) of each cargo C1, C2, C3 and C4 should be accepted and how to distribute each among the compartments such that the total profit for the flight is maximized. It is assumed that cargoes can be split into any fractions. Formulate the optimization problem.