## Problem:

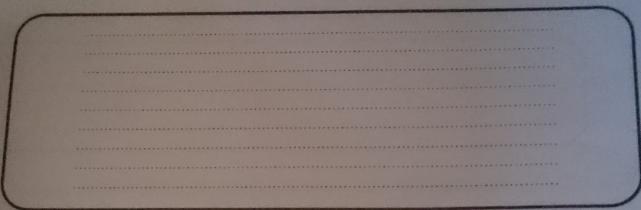
n boxes must be distributed in two containers. Each box has a different weight (box number i has m, kg). Help the workers to divide the boxes as best as possible in such a way that the weight is as much as equal distributed between the two containers, without opening or dividing a box.

Example: Consider: n = 7 and  $\mathbf{m} = \{3, 5, 2, 7, 2, 6, 10\}$ 

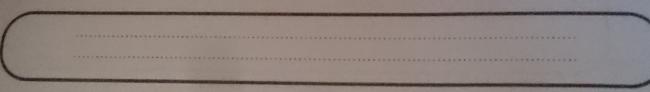
A possible solution is: for  $cont_1 = \{3, 5, 2, 7\}$  and for  $cont_2 = \{2, 6, 10\}$ 

In order to solve this problem 3 methods will be considered: BFS, EA and PSO

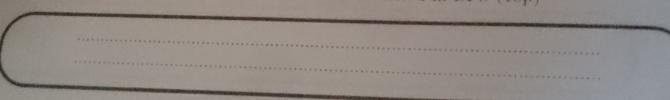
For a BFS search depict the search tree (not all, but enough to be clear how is built).
 (50p)



2 Describe the operator that is used in order to expand a node: (25p)



3. Write 5 nodes in the proper order if that tree is visited in BFS (10p)



4 What is a proper representation for an EA for this problem? (15p)

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(	ribe (pseudocode and/or example) a mutation for this representation (25p)
5. Desc	по (ре- 
Descri	be (pseudocode and/or example) a crossover for this representation (25p)
Vrite a	proper fitness for your representation for this problem (25p)
	I
scribe	a stop condition for the evolutionary algorithm (25p)

For the PSO algorithm that solve this problem:

9. How you initialise a particle's position? (example and/or pseudocode) (25)

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3	der the following and the
si	der the following pseudocode:
si fe	der the following pseudocode:
si fe	or each particle do
si fe	or each particle do
fe	r each particle do  determine best neighbour of the particle (ha)
si	der the following pseudocode:  or each particle do  determine best neighbour of the particle $(bn)$ for $i = 1$ , $len(particle)$ do

$$v_{i}^{(t+1)} = w * v_{i}^{t} + rand() * c_{1} * (x_{i}^{bn} - x_{i}^{t}) + rand() * c_{2} * (x_{i}^{b} - x_{i}^{t})$$

$$x_{i}^{t+1} = x_{i}^{t} + v_{i}^{(t+1)}$$
and for

6:

perform corrections to  $x_i^{t+1}$  and  $v_i^{(t+1)}$ 

end for

10. Identify the code line(s) from a typical PSO that will not work for this problem: explain

11. Describe a neighbourhood for a particle for this problem. (25)

12. Explain the line 7. from the pseudocode (in what representation is use, in which