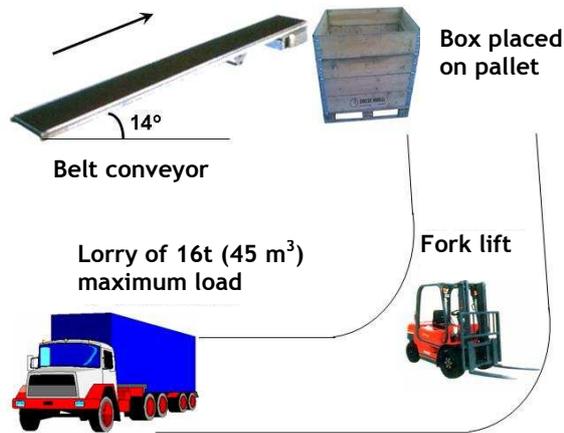## PROBLEM (2 points) / Time: 45 minutes

A company that distributes coffee has installed a transport system that follows the next scheme:


The transport system can be summarized as follows:

1. The coffee is transported in grains along the belt conveyor.
   a. The belt conveyor has an incline of 14°.
   b. The belt is supported in the work run by three idlers. The geometry is shown in the next figure:
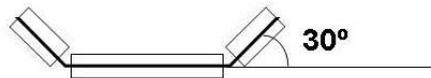
   c. The material to be transported are grains of coffee:
      i. Density: $620 kg/m^3$
      ii. Dynamic slope angle: 15°

2. The grains are stored in boxes which are placed on pallets.
   a. Box capacity: $2m^3$ (view the below figure)
   b. Do not take into account the box weight to carry out calculations.
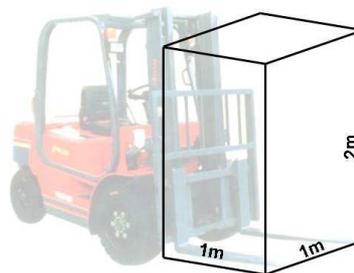
3. The boxes are transported by a fork lift.
   a. The height centre of gravity of the unloaded fork lift with respect to the floor is: 700mm
   b. When the fork lift is unloaded, consider that there is an homogenous load distribution between both axles.
   c. Below the rest of the fork lift features are given.
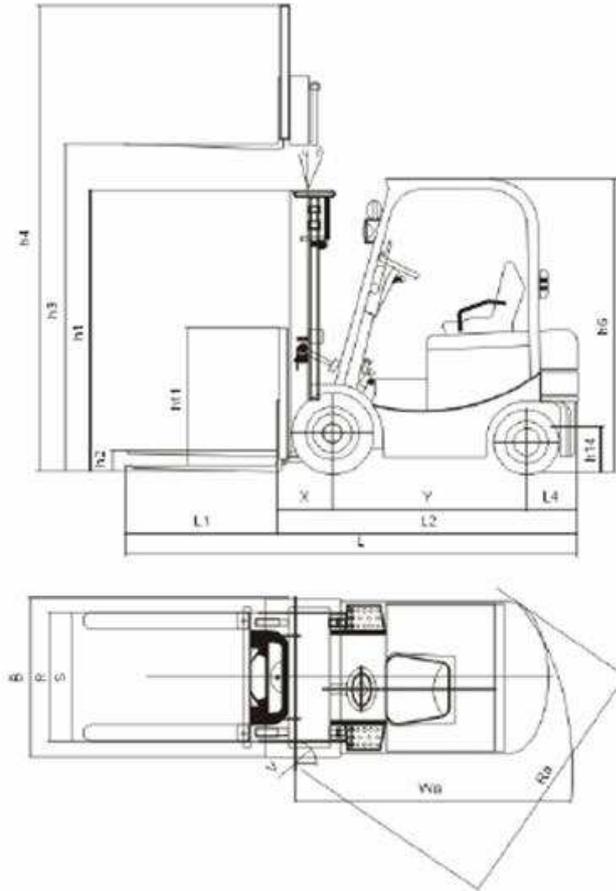
Model		FB16
Load Capacity	(Kg)	1600
Maximum lift speed	(mm/s)	300/600
Maximum travel speed	(km / h)	15
Maximum gradeability	(%)	15%
Travel electromotor power	(kW)	5
Lift electromotor power	(kW)	8.2
Turning electromotor power	(kW)	0.8
Battery voltage	(V)	48
Battery capacity	(Ah)	450
Total weight	(Kg)	3050
Overall height fork raised	h4 (mm)	4067
Max. Lifting height	h3 (mm)	3000
Overall height fork lowered	h1 (mm)	2015
Backrest height (from upper face of fork)	h11(mm)	994
Max free lift	h2(mm)	150
Overall lenght (with forks)	L(mm)	3205
Fork lenght	L1(mm)	1070
Front overhang	X(mm)	395
Wheel base	Y(mm)	1380
Rear overhang	L4(mm)	360
Overall height (overhead guard)	h6(mm)	2105
Overall width	B(mm)	1100
Lateral fork adjustment (outside fork)	R(mm)	200-950
Outside turning radius	Wa(mm)	1900
Tilting angles (fordward-backward)	α,β (°)	6°-12°

4. The fork lift transports the boxes from the discharge are to the loading area where there is a fleet of trucks.
   a. Maximum load that can be transported by the truck: 16t
   b. Interior volume of each truck: 45m^3

The installation must guarantee the exit, each hour, of two trucks full of coffee. It is asked:

1. Calculate, according to the recommended values given in tables, the minimum belt width the belt installation has to have.

2. Calculate, once fixed that belt width, the minimum speed between the standard ones at which the belt has to work.

3. Considering that the distance between the belt discharge area and the loading truck area is a straight path of 250m (500 m out and return trip) ¿is it possible for one fork lift to carry out all of the work? Consider that the fork lift travels at constant speed and do not take into account the loading and discharging times and that in each trip it transports as much boxes of 2m^3 as it can. The boxes must be put as shown in the above figure and the forks must be placed at the lowest possible level ("Max free lift" in the fork lift brochure).

4. ¿How much time will the fork lift need in each brake if it travels in the forward gear so as not to have stability problems?

5. ¿Could only one fork lift carry out all of the work if during the trip it must turn a bend of 1,9m radius with no incline? Consider again that the fork lift travels at constant speed.