1.

$$V_{lorry} = 16\frac{t}{lorry}\cdot\frac{m^3}{0,62t} = 25,8\frac{m^3}{lorry} < 45m^3$$

$$Q = 2\frac{lorry}{hour}\cdot 16\frac{tons}{lorry} = 32\frac{t}{h}$$

$$Q = 3600\cdot v\cdot A\cdot\gamma\cdot k$$

$Q = 32\ {}^{t}/_{h}$

$\gamma = 0,62\ {}^{t}/_{m^3}$

Incline (degrees)	2	4	6	8	10	12	14	16	18	20
k	1,0	0,99	0.,98	0,97	0,95	0,93	0,91	0,89	0,85	0,81

Material	B (mm)	V (m/s)
Grains and other materials that have a good fluidity and are not abrasive	500 650 and 800 1000 and 1200 1400 and 2400	2,62 3,35 4,19 5,24
Coal, clay pan, soft minerals and soils, grinned stones of little size	500 650 to 1000 1200 to 1200 1400 to 2400	2,09 3,35 4,19 5,24
Non abrasive	Any width	1,05 – 1,68

B\λ	0º	20º	25º	30º	35º	40º	45º
500	38 0,0105	74 0,0205	80 0,0222	87 0,0241	91 0,0252	95 0,0263	98 0,0272
650	69 0,0191	133 0,0369	144 0,0400	156 0,0433	164 0,0455	172 0,0477	176 0,0488
800	108 0,0300	208 0,0577	227 0,0630	244 0,0677	258 0,0716	269 0,0747	276 0,0766
1000	173 0,0480	336 0,0933	365 0,1013	394 0,1094	415 0,1152	434 0,1205	445 0,1236
1200	255 0,0710	494 0,1370	537 0,1491	580 0,1612	610 0,1705	638 0,1777	654 0,1828
1400	351 0,0980	680 0,1903	738 0,2071	798 0,2240	840 0,2368	878 0,2467	900 0,2536
1600	464 0,1294	898 0,2519	976 1055	1055 0,2965	1110 0,3134	1160 0,3264	1190 0,3355

$$Q = 3600 \cdot v \cdot A \cdot \gamma \cdot k = 3600 \cdot 2,62 \cdot 0,0241 \cdot 0,62 \cdot 0,91 = 128,25 \frac{t}{h} > 32 \frac{t}{h}$$

A belt width of 500mm is enough.

2.

$$32 = Q = 3600 \cdot v \cdot A \cdot \gamma \cdot k = 3600 \cdot v \cdot 0,0241 \cdot 0,62 \cdot 0,91 = 48,95v$$

$$\Rightarrow v = \frac{32}{48,95} = 0,65 \frac{m}{s}$$

0,66	0,84	1,05	1,31	1,68	2,09	2,62	3,35	4,19	5,24

The nearest value is 0,66 m/s

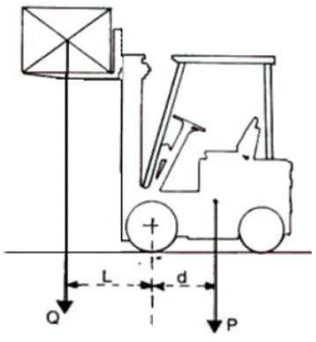
3.

$$2m^3 \cdot 0,620 \frac{t}{m^3} = 1,24t$$

1,24t<1,6t

$$\frac{32t}{1,24 \frac{t}{boxes}} = 25,8 \cong 26\ boxes \Rightarrow 26\ trips$$

$$\frac{26\ trips}{h} \Rightarrow 26 \cdot 500 = 13000 \frac{m}{h} = 13 \frac{km}{h}$$



$$9,8QL \leq 9,8Pd$$

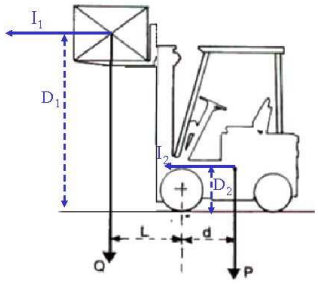
$$1240 \cdot \left(\text{front projection} + \frac{\text{load length}}{2} \right) \leq tara \cdot \frac{\text{distance between axles}}{2}$$

$$1240 \left(0,395 + \frac{1}{2} \right) \leq 3050 \cdot \frac{1,380}{2}$$

$$1109,8 \leq 2104,5 \Rightarrow \text{stability}$$

Yes, it is possible that the work is carried out by one fork lift truck

4.



$$9,8QL + I_1D_1 + I_2D_2 \le 9,8Pd$$
$$9,8QL + 9,8QaD_1 + 9,8PaD_2 \le 9,8Pd$$
$$1240\left(0,395+\frac{1}{2}\right)+Qa\left(\text{fork height}+\frac{\text{load height}}{2}\right)+0,7Pa \le 3050\cdot\frac{1,380}{2}$$
$$1109,8+1240a\left(0,15+\frac{2}{2}\right)+0,7\cdot 3050a \le 2104,5$$
$$1426a+2135a \le 2104,5-1109,8=994,7 \Rightarrow a=0,28\frac{m}{s^2}$$

$$v=v_0+at \Rightarrow 0=13\frac{1000}{3600}+0,28t \Rightarrow t=12'9s$$

For longitudinal stability reasons the fork lift will have to take at least 12,9 s to brake.

5.

$$V_{\text{rollover}}=\sqrt{gR\frac{B/2h+tg\zeta}{1-B/2h\cdot tg\zeta}} \underset{\zeta=0}{=} \sqrt{gRB/2h}$$

$$\left.\begin{array}{l} h_{\text{forklift c.o.g.}}=0,7m \\ h_{\text{load c.o.g.}}=0,15+1=1,15m \end{array}\right\} \Rightarrow h_{\text{total c.o.g.}}=\frac{0,7P+1,15Q}{P+Q}=\frac{2135+1426}{4290}=0,83m$$

$$V_{\text{rollover}}=\sqrt{gRB/2h}=\sqrt{\frac{9,8\cdot 1,9\cdot 1,1}{1,66}}=3,5\frac{m}{s}=12,6\frac{km}{h}$$

It is not possible for only one fork lift to carry out all of the work because the mean speed is 13 km/h which is bigger than the rollover speed.