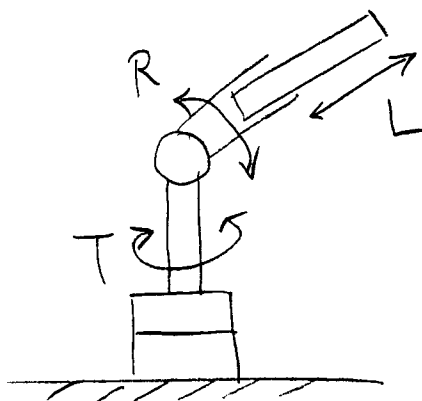
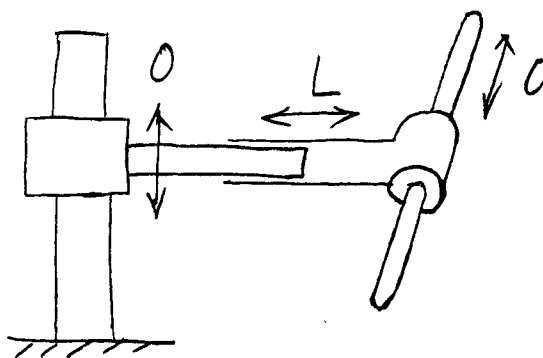


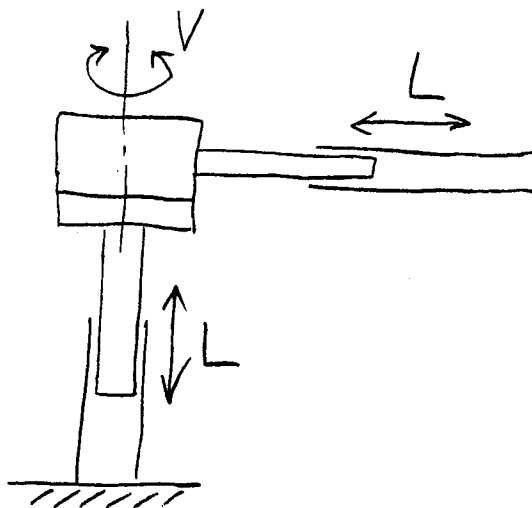
11.2 (a)



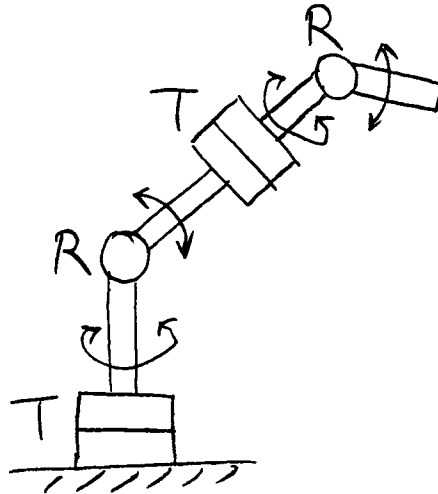
(b)



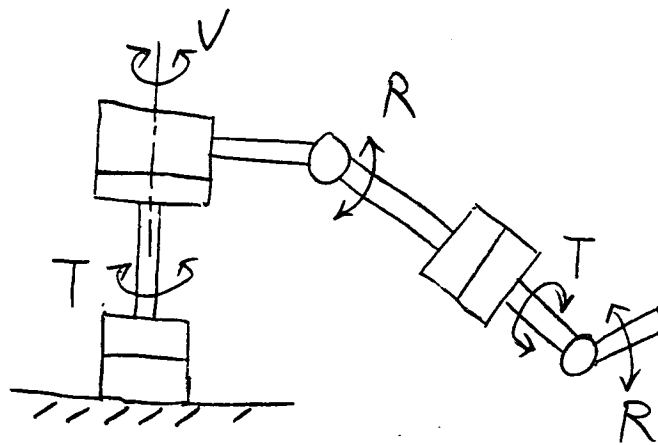
(c)



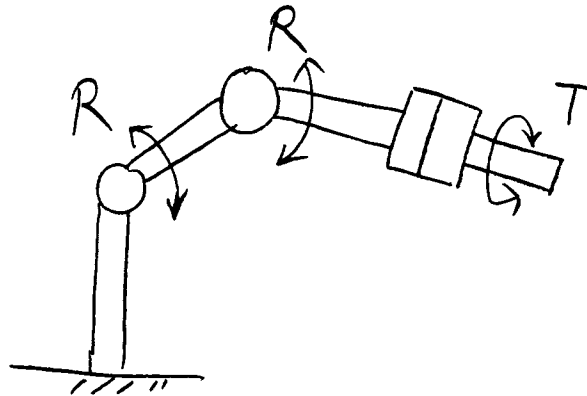
11.3 (a)



(b)



(c)



13.2

$$\text{Cycle time} = 33.0 + 5.0 = 38.0 \text{ sec}$$

$$\text{tool change time} = \frac{3.0}{30} \times 60 = 6.0 \text{ sec/piece}$$

$$\text{average production time} = 38.0 + 6.0 = 44.0 \text{ sec}$$

The hourly production rate with consideration of uptime efficiency is

$$R_p = \frac{3600}{44} \times (1 - 0.03 - 0.02) = 77.7 \text{ pieces/hr}$$

13.3

$$\text{Cycle time} = 5.5 + 33.0 + 4.8 + 1.7 = 45.0 \text{ sec}$$

$$\text{tool change time} = 6.0 \text{ sec/piece}$$

$$\text{average production time} = 45.0 + 6.0 = 51.0 \text{ sec/piece}$$

The hourly production rate for two machine tools with consideration of the robot and machine tool uptime efficiency is

$$\begin{aligned} R_p &= \frac{3600}{51} \times 2 \times 0.97 \times 0.98 \\ &= 134.2 \text{ pieces/hr} \end{aligned}$$