Ancillary Material #1 Solutions

(1) (a) We have

- 12 links (w/o the fixed link)
- 13 revolute joints
- 3 prismatic joints

The revolute joints each constrains 2 dof, the prismatic joints each constrains 2 dof.
Hence,

$$DoF = 3(12) - 2(13) - 2(3) = \underline{4}$$

↑ planar mobility of each rigid body.

(b) There are

- 7 links (w/o the fixed link)
- 7 revolute joints
- 1 prismatic joint
- 1 fork joint

$$DoF = 3(7) - 2(7) - 2(1) - 1 \cdot 1$$

$$= \underline{4}.$$

(c) We have

- 13 links (w/o the fixed link)
- 16 revolute joints
- 2 prismatic joints

$$DoF = 3(13) - 2(16) - 2(2) = \underline{3}.$$

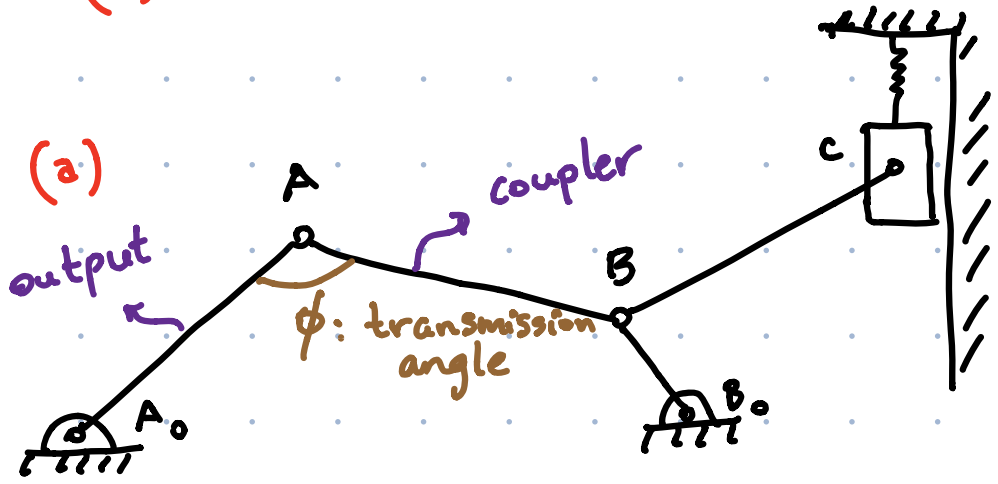
(2) (a) A fourbar linkage

(b) A slider-crank mechanism

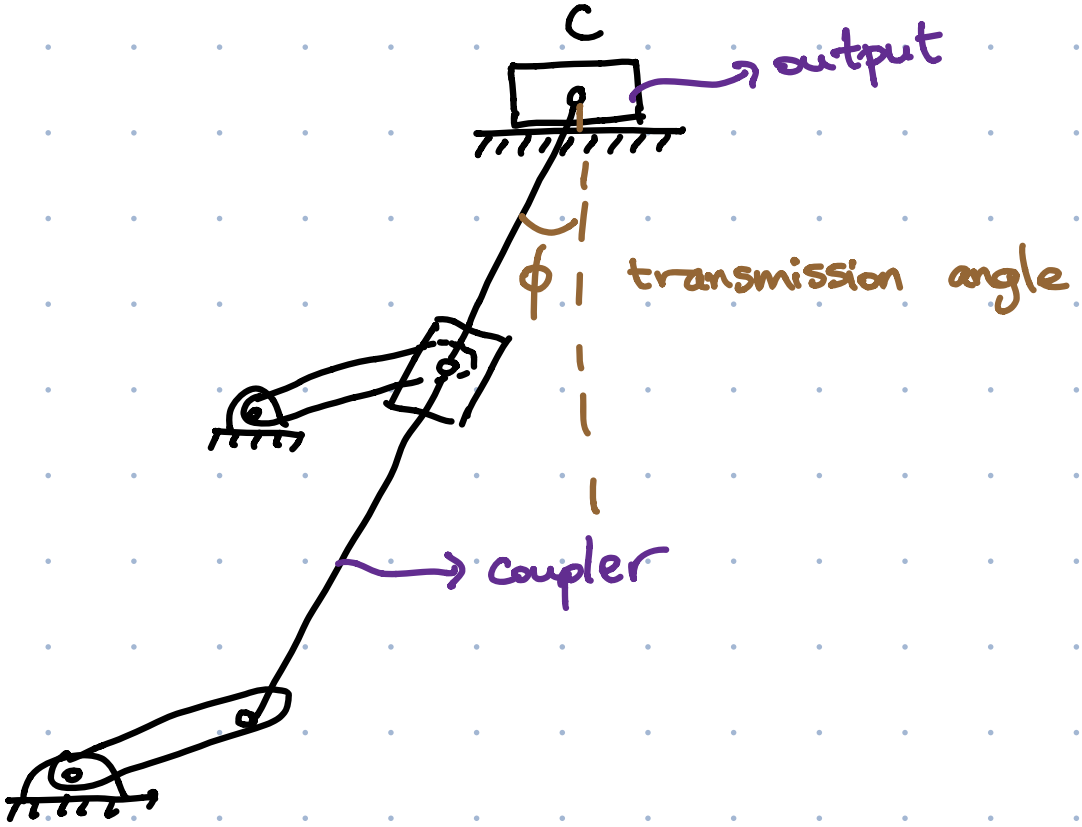
(c) A slider-crank mechanism w/ multiple sliders.

(d) A slider-crank mechanism.

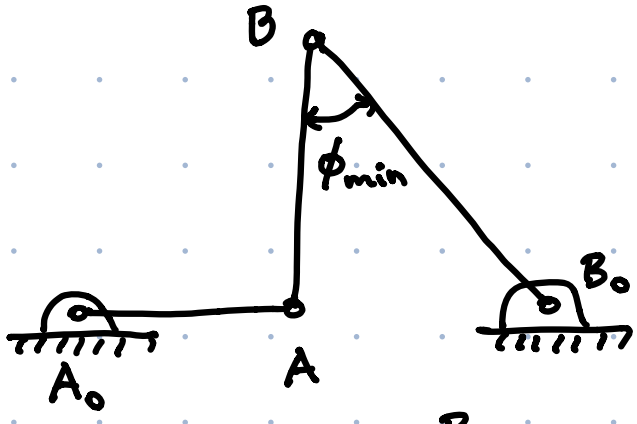
(3) (a)



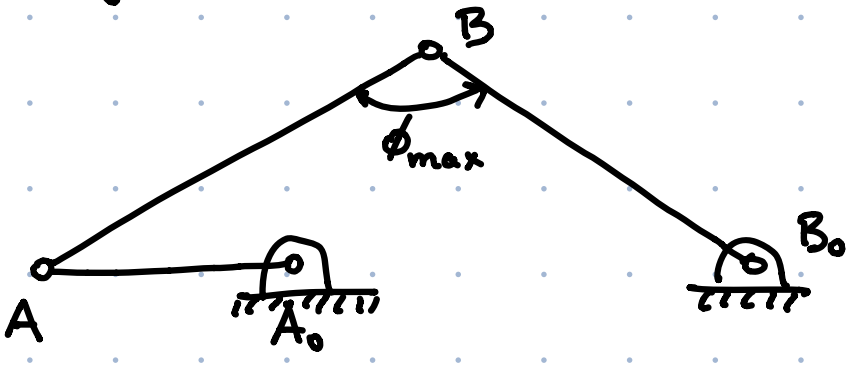
(b)



(c)



Minimum value of the transmission angle



Maximum value of the transmission angle.

$A_0B_0 = 6$ cm., $A_0A = 1$ cm., $AB = 2$cm., $BB_0 = 6$cm.

$$\cos(\phi_{min}) = \frac{(AB)^2 + (BB_0)^2 - (AB_0)^2}{2(AB)(BB_0)} = \frac{2^2+6^2-5^2}{2\cdot 2\cdot 6} = \frac{15}{24}$$

$$\Rightarrow \phi_{min} \approx 0.8957 \text{ rad} \approx 51.3178^\circ$$

$$\cos(\phi_{max}) = \frac{(AB)^2 + (BB_0)^2 - (AB_0)^2}{2(AB)(BB_0)} = \frac{2^2+6^2-7^2}{2\cdot 2\cdot 6} = -\frac{9}{24}$$

$$\phi_{max} \approx 1.95 \text{ rad} \approx 112^\circ.$$