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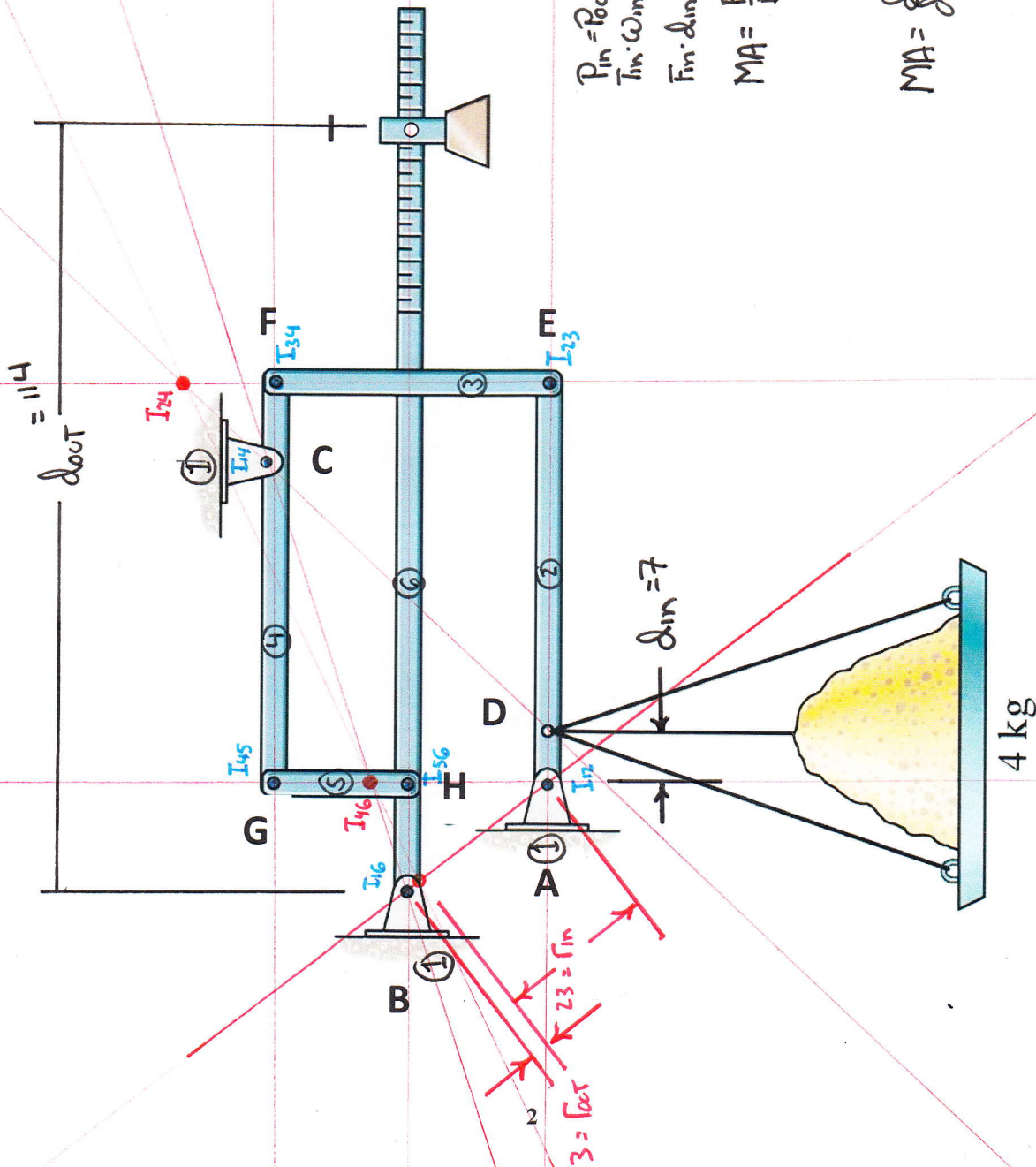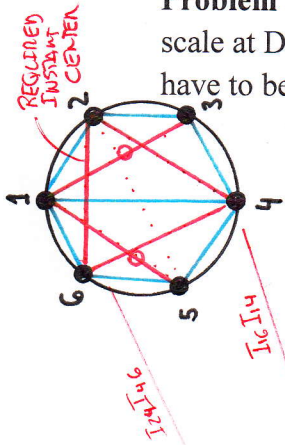
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Signature: _____

Print Name: _____SOLUTION_____

Exam Date: _____30 OCTOBER 2013_____

Problem 1 (25pts): The pan scale below has 4kg of a material on its pan that is attached to the scale at D. Given the counter weight is located at I, what does the weight of the counter weight have to be to keep the scale in balance.

$$\boxed{32g}$$

$$P_{in} = P_{out}$$
$$F_{in} \cdot \omega_{in} = F_{out} \cdot \omega_{out}$$
$$F_{in} \cdot d_{in} = F_{out} \cdot d_{out} = \frac{H_{out}}{F_{out}}$$

$$MA = \frac{F_{out}}{F_{in}} = \frac{d_{in}}{d_{out}} \cdot \frac{F_{out}}{F_{in}} \Big| \frac{V_{in}}{V_{out}} \quad @I_{2c} \quad V_{in} = V_{out}$$

$$MA = \frac{d_{in}}{d_{out}} \cdot \frac{F_{out}}{F_{in}} = \frac{7}{114} \cdot \frac{3}{23}$$

$$\boxed{= 8.0(10^{-3})}$$

$$MA = \frac{F_{out}}{F_{in}} = 8.0(10^{-3}) = \frac{F_{out}}{4(10^3)g}$$

$$F_{out} = 8.0(10^{-3}) \cdot 4(10^3)g = 32g$$

$$d_{out} = 114$$
$$d_{in} = 7$$

$$23 = r_{in}$$
$$3 = r_{out}$$

4 kg

Problem 2 (25pts): The link AB in 2.6in in length and rotates as shown at 10 1/s. Determine *1* the velocities of points B, D, and E. Determine the angular velocities of links 3,4,5&6.

$$\forall_B = \omega_2 \cdot r_B = (10 \, ^1/_s)(2.6_{in}) = \boxed{26 \, ^{in}/_s}$$

$$\omega_3 = \frac{\forall_B}{r_{B \, I_{13}}} = \frac{26 \, ^{in}/_s}{8.4_{in}} = \boxed{3.1 \, ^1/_s \; cw}$$

$$\forall_{I_{24}} = 12 \, ^{in}/_s \quad \text{MEASURED}$$

$$\omega_4 = \frac{\forall_{I_{24}}}{r_{I_{14} I_{24}}} = \frac{12 \, ^{in}/_s}{4_{in}} = \boxed{3 \, ^1/_s \; cw}$$

$$\forall_D = \forall_{I_{45}} = \boxed{31 \, ^{in}/_s} \quad \text{MEASURED}$$

$$\omega_5 = \frac{\forall_D}{r_{I_{15} D}} = \frac{31 \, ^{in}/_s}{3.9_{in}} = \boxed{7.9 \, ^1/_s \; ccw}$$

$$\forall_E = \forall_{I_{56}} = \boxed{37 \, ^{in}/_s} \quad \text{MEASURED}$$

$$\omega_6 = \frac{\forall_E}{r_{I_{16} E}} = \frac{37 \, ^{in}/_s}{3.7} =$$

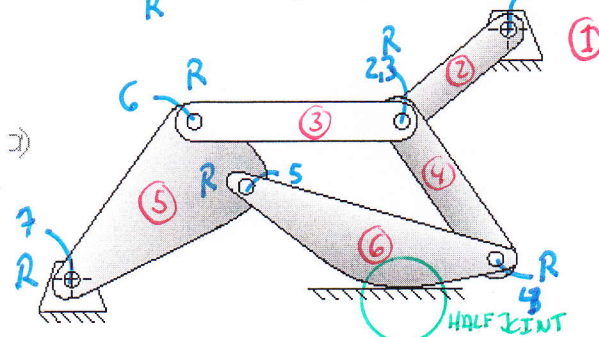$$= \boxed{10 \, ^1/_s \; cw}$$
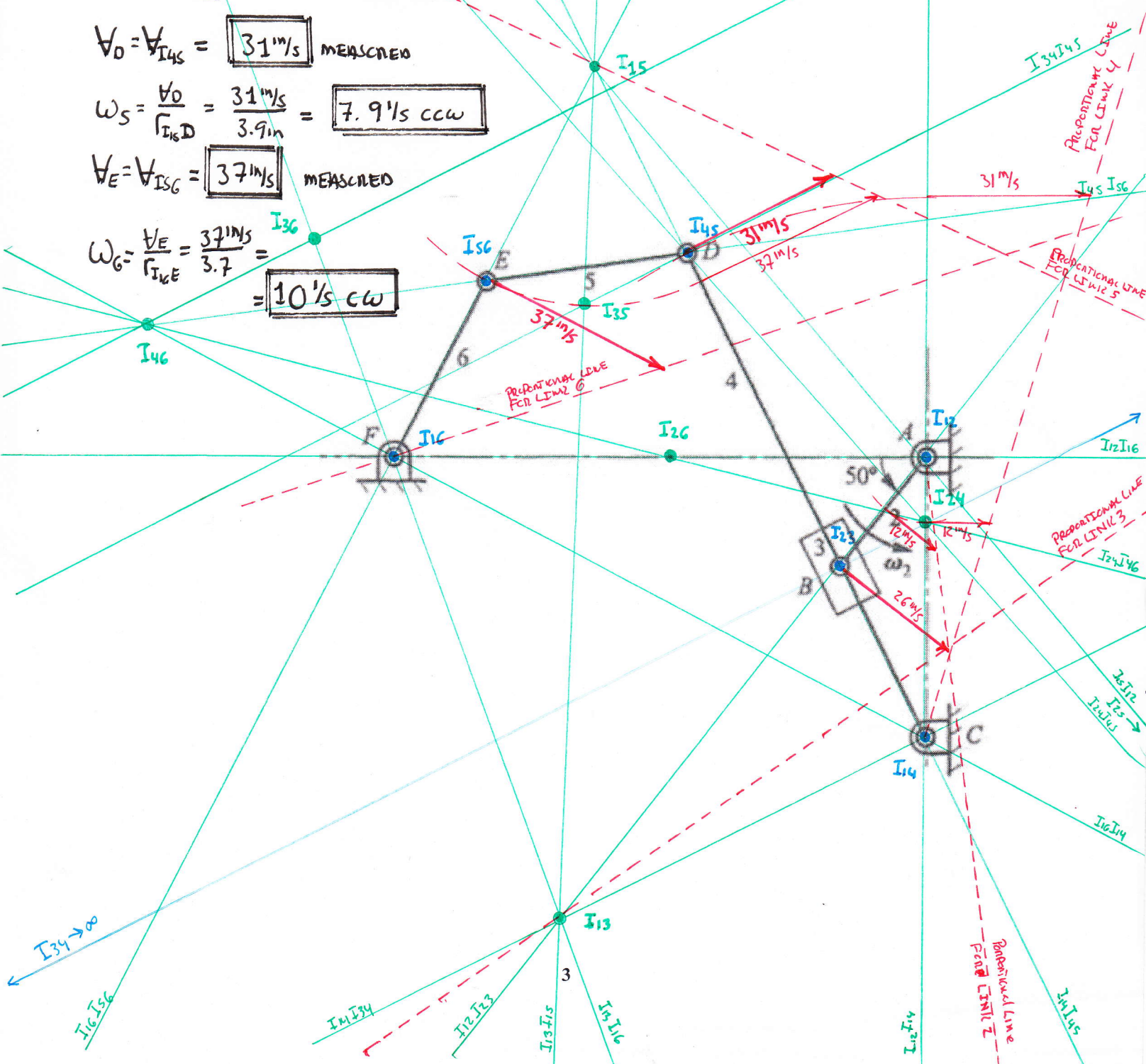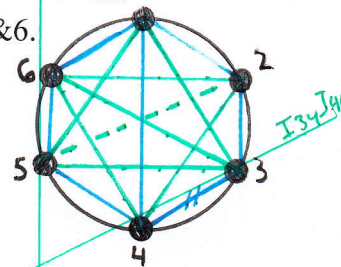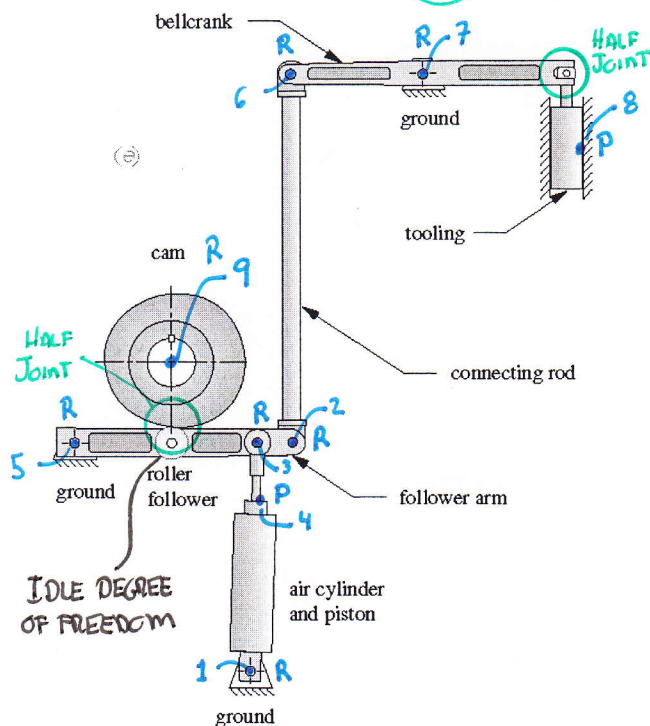
Problem 3: For the mechanisms shown below:
a. Identify the type of joint (full, half, prismatic (P), revolute (R), cam (C)) directly on the figure
b. Number each link
c. Calculate the mobility of the mechanism
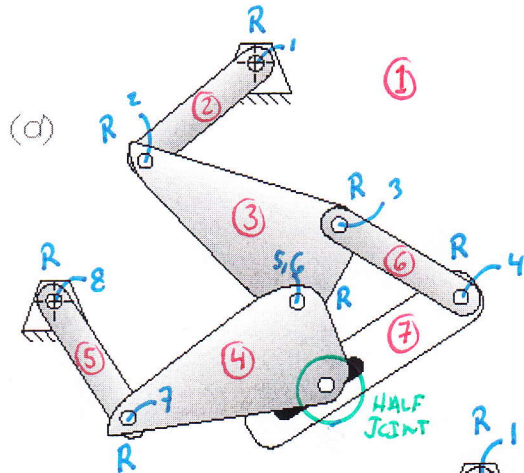
$$M = 3(L-1) - 2 \cdot J_1 - J_2$$
$$= 3(7-1) - 2 \cdot 7 - 1$$
$$= 18 - 14 - 1 = \boxed{3}$$

$$M = 3(L-1) - 2 \cdot J_1 - J_2$$
$$= 3(6-1) - 2 \cdot 7 - 1$$
$$= 15 - 14 - 1 = \boxed{0}$$

$$M = 3(L-1) - 2 \cdot J_1 - J_2$$
$$= 3(8-1) - 2(9) - 2$$
$$= 21 - 18 - 2 = \boxed{1}$$

bellcrank

HALF JOINT

ground

tooling

cam

HALF JOINT

connecting rod

roller follower

ground

follower arm

air cylinder and piston

IDLE DEGREE OF FREEDOM

ground

Problem 4: Synthesize a mechanism that will move link CD through the three positions shown. After the mechanism has been synthesized, add a drive dyad to power the mechanism.
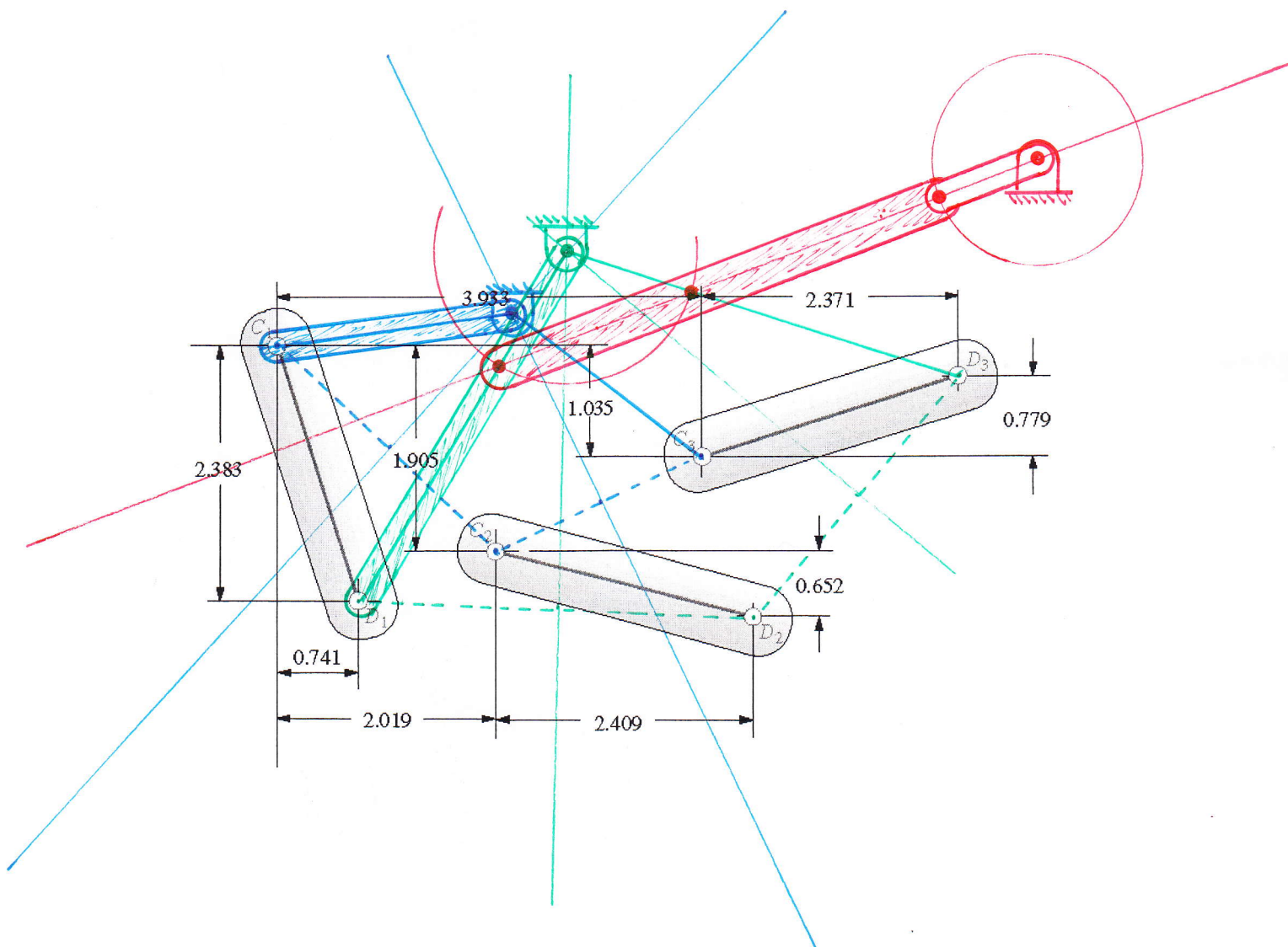
Bonus:

(1pts): What is the Answer to the Ultimate Question of Life, the Universe, and Everything?

42

(1pts): In what book was this discussed?

THE HITCHHIKER'S GUIDE TO THE GALAXY

(1pt): What species did the hyper-intelligent pan-dimensional beings who built the computer to calculate this answer disguise themselves as?

MICE

(1pt): What form did the computer take that was designed to calculate the question to the answer above?

EARTH

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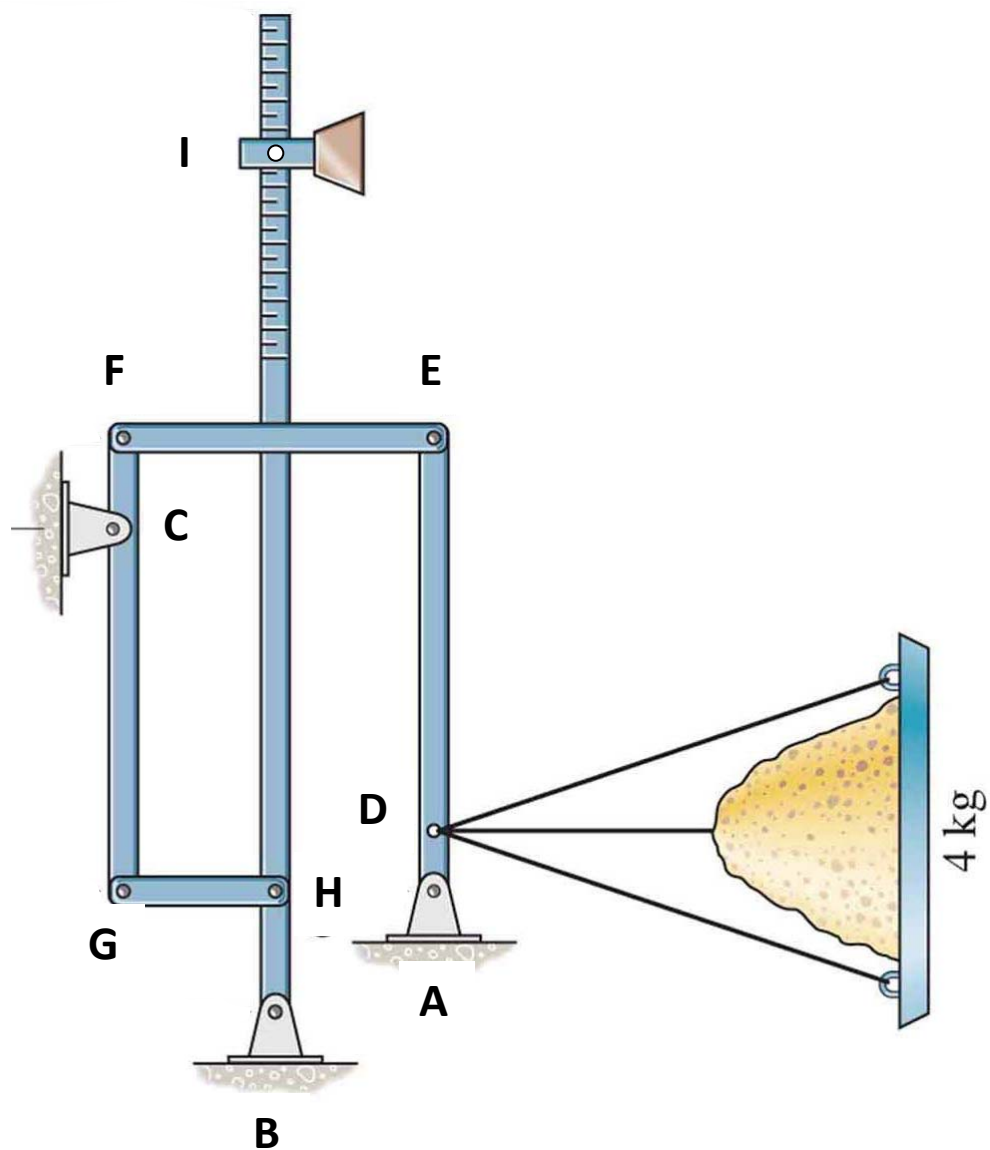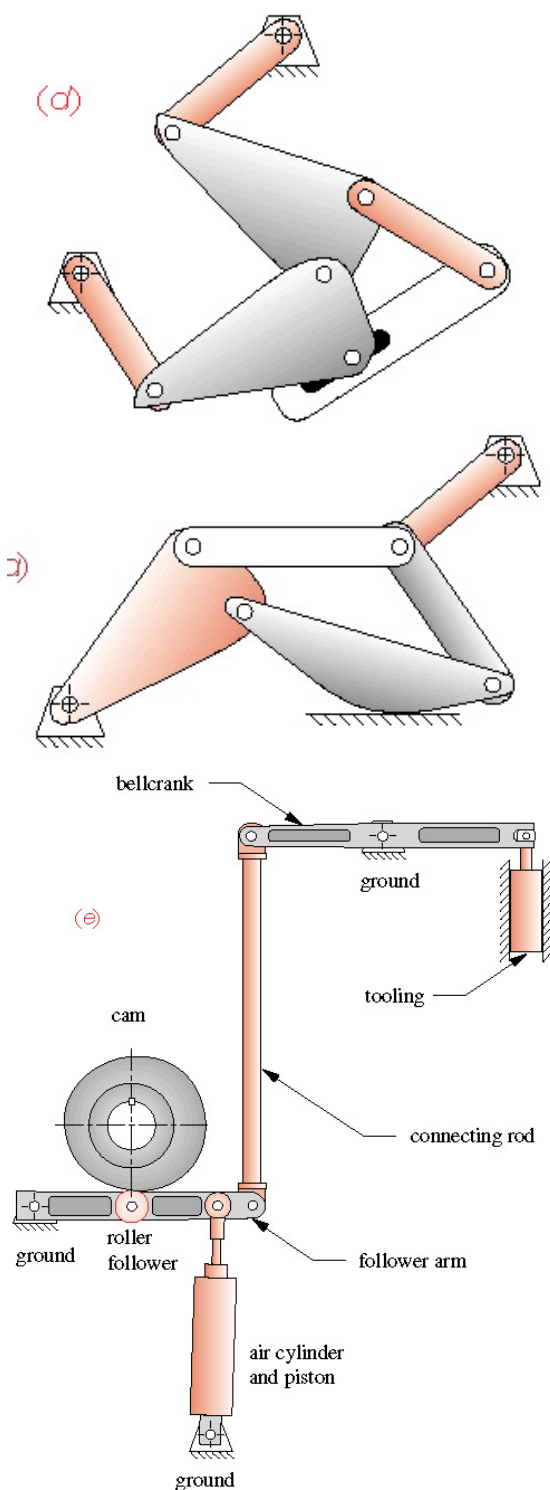
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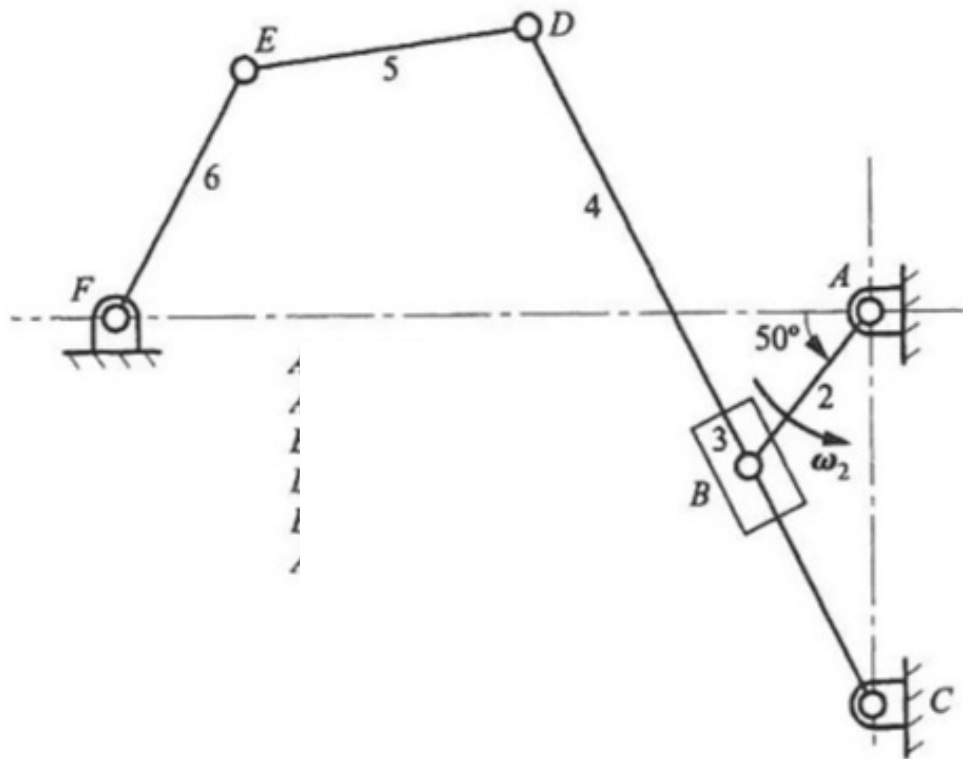
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(d)

d)

bellcrank

ground

(e)

cam

connecting rod

roller
follower

ground

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air cylinder
and piston

ground

tooling

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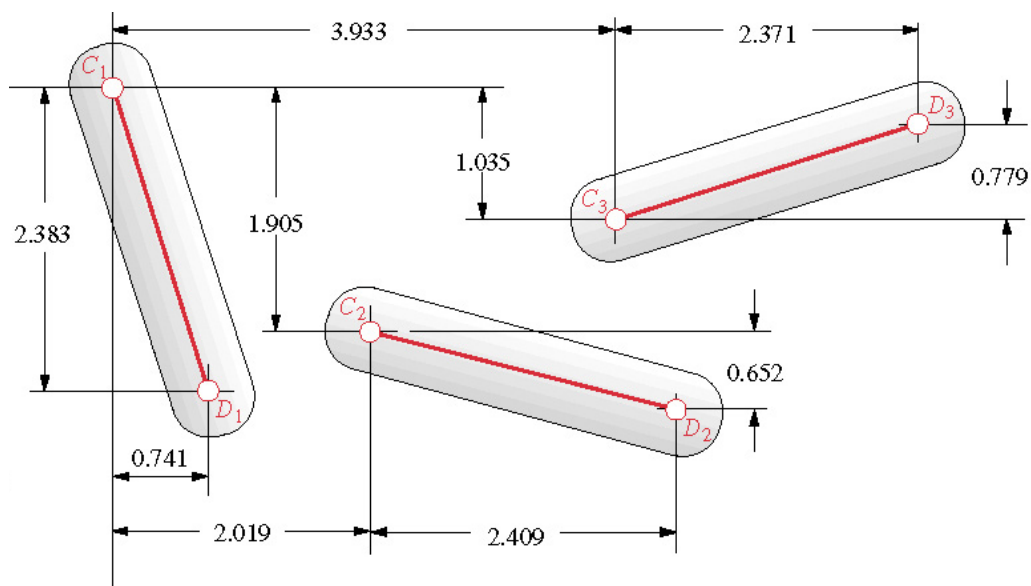
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