1. As shown in figure 1, a vertical load **W** is applied to the linkage at *B*. The constant of the spring is ***k***, and the spring is unstretched when *AB* and *BC* are horizontal. Neglecting the weight of the linkage, ***use principle of virtual work*** to derive an equation in ***θ, W, l,*** and ***k*** that must be satisfied when the linkage is in equilibrium. If you use methods other than the *principle of virtual work*, only maximum up to 10 points will be given. (20%)

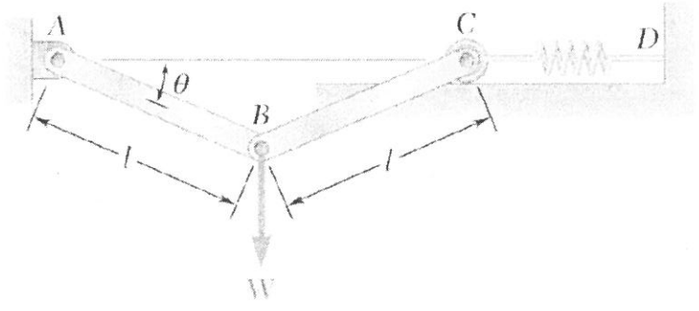


Figure 1

2. For the frame and loading shown in figure 2, determine the x- and y-components of all forces acting on member ***ABE***. (20%)

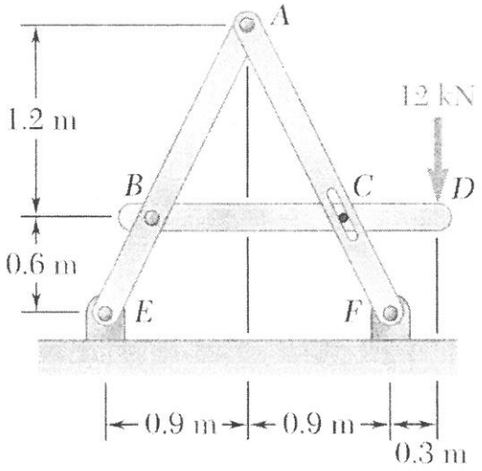
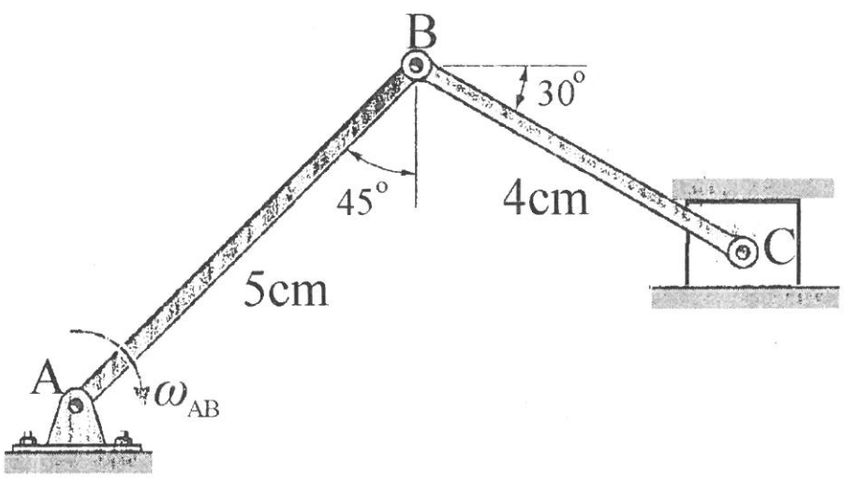
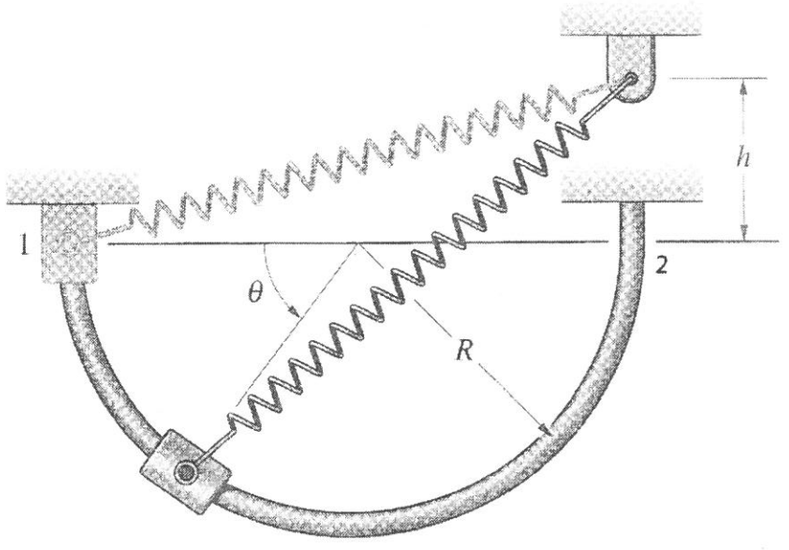


Figure 2

3. Determine the angular velocity of link AB at the instant shown if block C in moving right-ward at 12cm/s. (20%)



4. In the mechanical delay switch shown in Figure, and electromagnet releases the 1 kg slider at position 1. Under the actions of gravity and the linear spring, the slider moves along the smooth bar from position 1 to position 2, closing the switch. The constant of the spring is k = 40N/m, and its unstretched length is r_0 =50 mm. The dimensions are R = 200 mm and h = 100 mm. Pleaser determine the velocity of the slider's when the θ = 60 deg. (20%)



5. The slender bar of length l and mass m is pinned to the vertical shaft at O. The vertical shaft rotates with a constant angular velocity ω_0. Please find the value of necessary for the bar to remain at a constant angule β relative to the vertical. (20%)