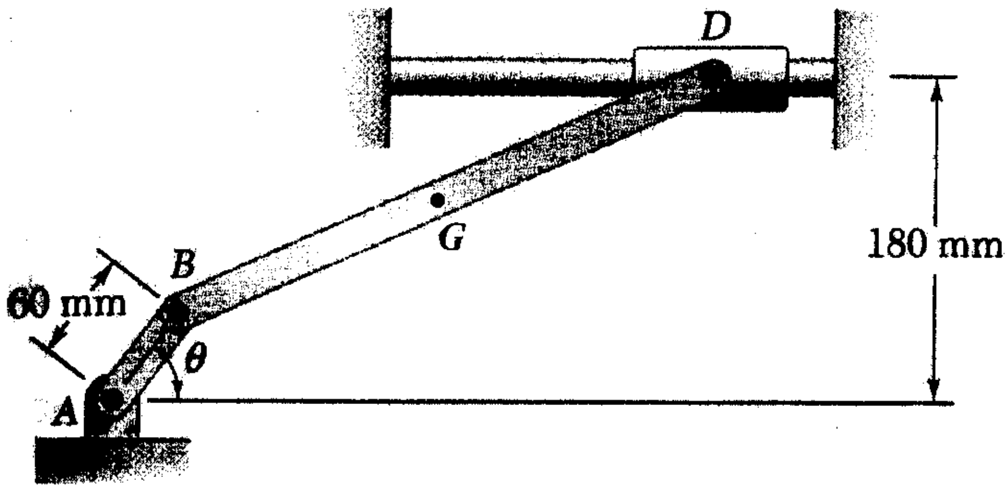
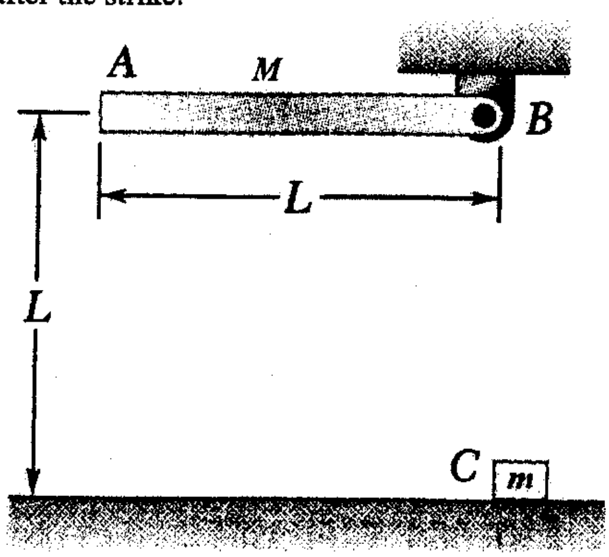
※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. (30%) The 300mm uniform rod *BD* of mass 3kg is connected as shown below. Crank *AB* and collar *D* are both massless. It is given that crank *AB* rotates counterclockwise at the constant rate of 30rad/sec and collar D slide smoothly along a horizontal rod. Answer the following questions at the instant when θ=30°. Neglect gravity.
   (a) (12%) Analytically determine the acceleration of mass center point *G* ($\mathbf{a}_G$) and angular acceleration of rod *BD* ($\boldsymbol{\alpha}_{BD}$).
   (b) (18%) Determine the moment required at joint *A* to produce such motion.



2. (20%) A slender rod *AB* of mass *M* and length *L* is released from rest in the position shown below. Due to downward gravity acceleration *g*, the rod swings downward to a vertical position and strikes block *C* of mass *m*. Assume that the coefficient of restitution between rod *AB* and block *C* is zero, and the coefficient of friction between block *C* and the plane is μ.
   (a) (10%) Determine the velocity of block *C* (v_C) immediately after the strike.
   (b) (10%) Find the distance moved by block *C* before it stops. Assume that the rod is removed from the problem after the strike.



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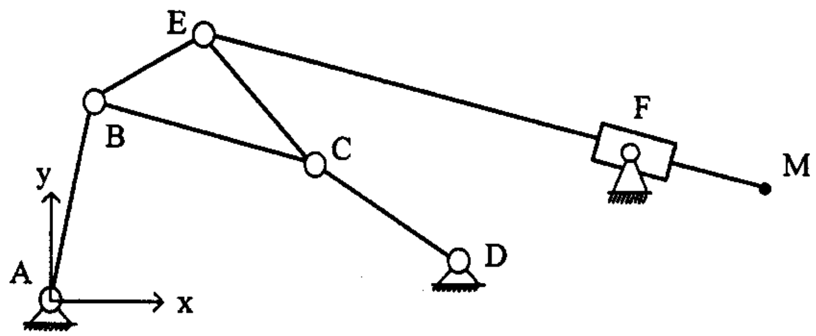
3. (30%) Given the 6-bar linkage shown in the figure, determine the velocity and acceleration of point M. The angular velocity of link AB is $2\ rad/\sec$ (counterclockwise, constant). Note that a turning block is attached to joint F, and link EM can only slide relative to the turning block. As shown in the figure, joints A, D, and F connect the linkage to the ground link. Use an analytical method to solve this problem. (Do not use graphical methods because the figure is not drawn to scale.) The coordinates of the positions of the six revolute joints are: $A(0,0)$, B(1,5), C(8,4), D(12,1), E(5,7), F(17,4), M(20,3). The unit used here is *cm*.



4. (20%) Carefully read the following two paragraphs of a statement. You are asked to (a) (10%) precisely translate the first paragraph into Chinese and (b) (10%) write down the equation(s) on your answer sheet as instructed in the second paragraph.

Inertia is the resistance of an object to a change in its state of motion; it is not force by definition. Engineers, however, frequently utilize a term called inertia force. The idea of this force is to use the concepts of statics to introduce dynamics. The inertia force of an object is defined as the negative of its mass times its acceleration. As a result, the dynamic equation becomes the sum of all forces, including the inertia force, being zero. This is a more comprehensible approach to introducing dynamics to people who have done a lot of static calculations.

Take a number of n external forces applying on an object with mass m for example. The forces are denoted by vectors **f** with subscript i. First, write down the equation of Newton's second law. The left-hand side of the equation is the sum of the external forces. Use the summation notation to denote the sum. Note that the index i is from one to n. Let the acceleration be denoted by a vector **a**. The right-hand side of the equation is of course the mass times the acceleration. Second, move the term in the right-hand side of the above equation to its left-hand side. Write down the equation again. Third, write down the definition of inertia force by using vector **f** with subscript *in* to denote the inertia force. Finally, substitute the definition of inertia force into the dynamic equation. Now you have an equation in the form similar to one seen in statics. Namely, the sum of all external forces and the inertia force equals zero. Write down this equation too.