1. A man weighing 70 kg sits on a sling and supports himself by a rope wound 1.5 turns around fixed pulley (Fig. 1). Given that the coefficient of friction between the rope and pulley is 0.3, what is the minimum force he can exert to maintain his position? (10%)

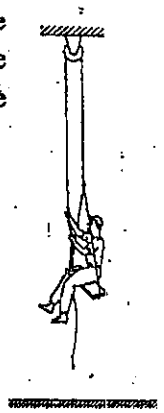


Fig. 1

2. Determine the tension in the cables and also the force **P** required to support the 600-N force using the frictionless pulley system shown in Fig. 2. (10%)

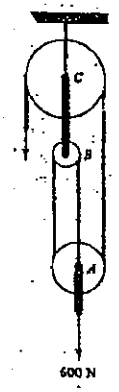
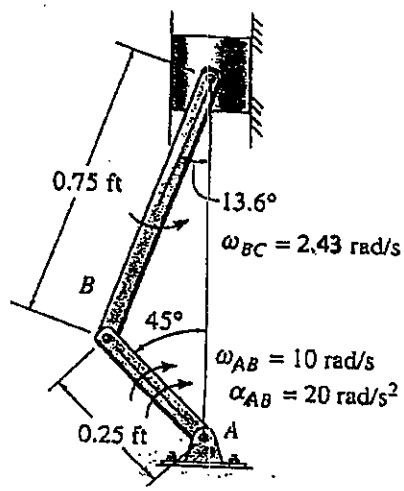


Fig. 2

3 (a) What is the principle of virtual work? (5%)
(b) Under what conditions you can apply the principle of virtual work? (5%)
(c) What are stable, unstable and neutral equilibrium of force systems? (5%)

4 The crankshaft AB turns with a clockwise angular acceleration of 20 rad/s^2. Determine the acceleration of the piston at the instant AB is in the position shown. At this instant ω_{AB} = 10 rad/s and ω_{BC} = 2.43 rad/s. (15%)



5. Find a unit normal vector **n** of the cone of revolution $z^2 = 4(x^2 + y^2)$ at the point P: (1, 0, 2). (10%)

6. Find the general solution of equation

$$y'' - 2y' + y = e^x \quad (15\%)$$

7. 求 $\int_0^{\frac{\pi}{2}} \sin^2\theta \cos^4\theta \, d\theta$ 之積分。 (15%)

8. If matrices A and B are defined as $A = \begin{bmatrix} 9 & -5 \\ -2 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 \\ 0 & 5 \end{bmatrix}$, then the product $C = A^T B^{-1}$ is

(A) $\begin{bmatrix} 9 & -1 \\ 3 & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 5 & -6 \\ -13 & 8 \end{bmatrix}$ (C) $\begin{bmatrix} -5 & 2 \\ -21 & -7 \end{bmatrix}$ (D) $\begin{bmatrix} 15 & -21 \\ 21 & 8 \end{bmatrix}$ (E) None (10%)