

國立成功大學
110學年度碩士班招生考試試題

編 號： 73

系 所： 機械工程學系

科 目： 動力學

日 期： 0202

節 次： 第 2 節

備 註： 可使用計算機

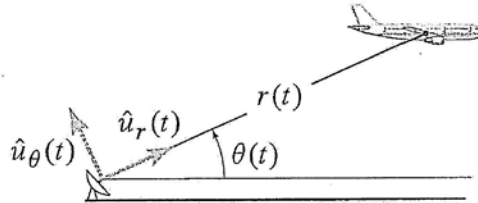
※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (20%) During a given time interval, a radar station tracking an airplane records the readings

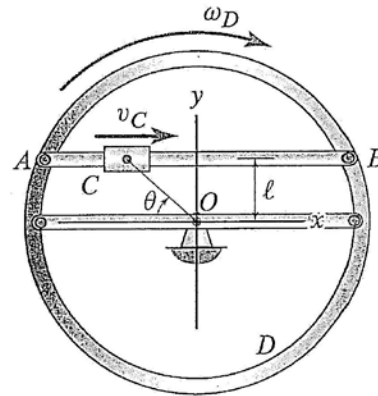
$$\dot{r}(t) = [700 \cos \theta(t) + 100 \sin \theta(t)] \text{ km,}$$

$$r(t)\dot{\theta}(t) = [100 \cos \theta(t) - 700 \sin \theta(t)] \text{ km,}$$

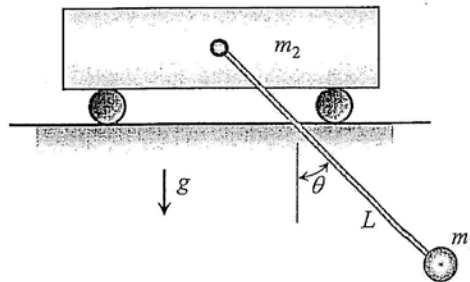
where t denotes time. Determine the speed of the plane. Furthermore, determine whether the plane being tracked is ascending or descending and the corresponding climbing rate (i.e., the rate of change of the plane's altitude).



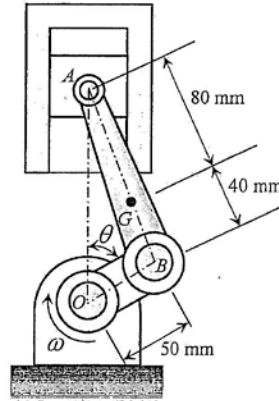
2. (20%) The wheel D rotates with a constant angular velocity $\omega_D = 14 \text{ rad/s}$ about the fixed point O , which is assumed to be stationary relative to an inertial frame of reference. The xy frame rotates with the wheel. Collar C slides along the bar AB with a constant velocity $v_C = 4 \text{ ft/s}$ relative to the xy frame. Letting $l = 0.25 \text{ ft}$, determine the inertial velocity and acceleration of C when $\theta = 25^\circ$. Express the result with respect to the xy frame.



3. (20%) A sphere of mass $m_1 = 0.5 \text{ kg}$ and small diameter is suspended by a wire of length $L = 0.5 \text{ m}$ from a carriage of mass $m_2 = 5 \text{ kg}$ which is free to roll along the horizontal rails. If the sphere and carriage are released from rest with the wire making an angle $\theta = 45^\circ$ with the vertical, determine the velocity v_c of the carriage and the angular velocity ω of the wire at the instant when $\theta = 0^\circ$. Neglect all friction and treat the carriage and the sphere as particles in the vertical plane of motion.



4. (20%) The 0.5-kg connecting rod AB of a certain internal-combustion engine has a mass center at G and has a radius of gyration about G of 30 mm. The piston and piston pin A have a combined mass of 0.7 kg. The engine is running at a constant speed of 2400 rev/min. Neglect the weights of the components and the force exerted by the gas in the cylinder compared with the dynamic forces generated. Determine the magnitude of the force on the piston pin A for the crank angle $\theta = 90^\circ$.



5. (20%) Consider a vibration system shown in the figure. The mass of the block is $m = 0.8$ kg. The spring constant and damping coefficient are $k = 80$ N/m and $c = 0.4$ N-s/m, respectively. Neglect the mass and friction of the pulley. Derive the equation of motion. Determine the natural frequency and the damping ratio of the vibration system. Is the vibration system underdamped, critically damped or overdamped?

