國立成功大學

115學年度碩士班招生考試試題

編　號：94

系　所：航空太空工程學系

科　目：工程力學

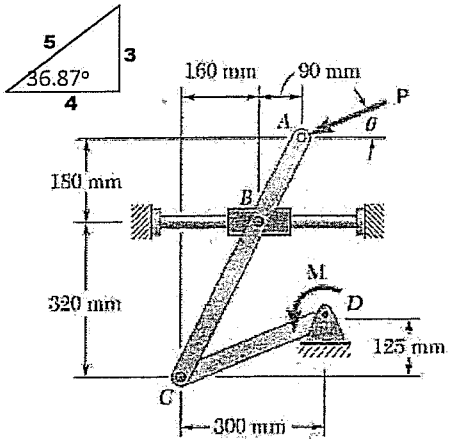
日　期：0203

節　次：第 2 節

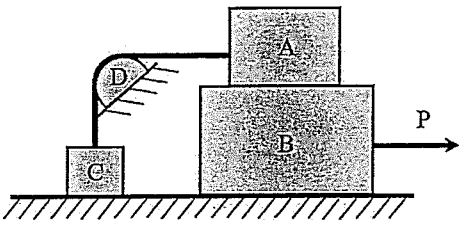
注　意：1.不可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

※ 考生請注意：本考試請於答案卷作答，於本試題紙上作答者，不予計分。

1. Arm *ABC* is connected by pins to a collar at *B* and to a crank *CD* at *C*. Assume the weights of all members are negligible and that collar *B* freely moves along the horizontal rod with negligible friction. Determine:
   (a) (15%) The torque *M* required to hold the system in equilibrium if θ = 0°. (Express *M* in terms of *P*).
   (b) (10%) Compute the value of the applied force *P* required to hold the system in equilibrium, if θ = 36.87° and *M* = 300 N·mm.

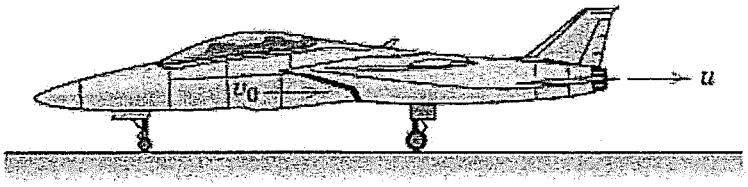


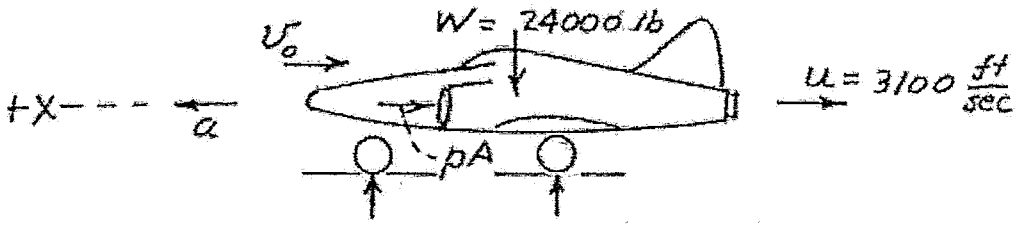
2. A 30 N block *A* rests on top of a 150 N block *B*. Block *A* is connected to a 50 N block *C* by a cord that passes over a drum *D*. The cord and drum *D* are assumed to be frictionless. The coefficient of static friction is 0.3 between blocks *A* and *B*, and 0.4 between block *B* and the ground. Assume that no tipping occurs.
   (a) (10%) Determine the minimum force P required to initiate motion of block B.
   (b) (5%) Using the result from part (a), determine the friction force between blocks A and B at the onset of motion of block B.
   (c) (5%) If the weight of block C is reduced to 5 N, determine the minimum force P required to initiate motion of block B.
   (d) (5%) Using the result from part (c), determine the friction force between blocks A and B at the onset of motion of block B.



3. (Total 25%):

The military jet aircraft has a gross weight of 24,000 lb and is poised for takeoff with brakes set while the engine is revved up to maximum power. At this condition, air with a specific weight of 0.0753 lb/ft^3 is sucked into the intake ducts at the rate of 106 lb/sec with a static pressure of -0.30 lb/in.^{2} (gage) across the duct entrance. The total cross-sectional area of both intake ducts (one on each side) is 1800 in.^{2} The air–fuel ratio is 18, and the exhaust velocity u is 3100 ft/sec with zero back pressure (gage) across the exhaust nozzle. Compute the initial acceleration a of the aircraft upon release of the brakes and the following rates.





(4%) Air intake mass rate: $\dot{m}'_{air\_in}$ = _____$(lb \times sec/ft)$ Options: (a) 106, (b) 3.29, (c) 5.89, (d) 59.2, (e) 0.183, (f) 113, (g) 10900

(4%) Fuel mass rate: $\dot{m}'_{fuel}$ = _____$(lb \times sec/ft)$ Options: (a) 106, (b) 3.29, (c) 5.89, (d) 59.2, (e) 0.183,(f) 113, (g) 1908

(4%) Air intake velocity: v_0 = _____(ft/sec) Options: (a) 0.0243, (b) 0.782, (c) 3.50, (d) 14.7, (e) 0.183, (f) 113, (g) 10900

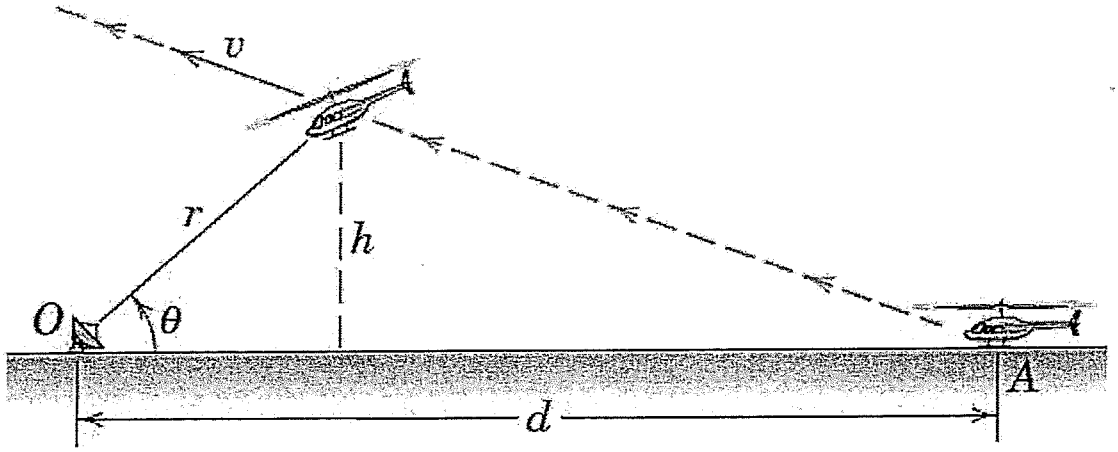
(4%) Exhaust mass rate: $\dot{m}'_{exhaust}$ = _____$(lb \times sec/ft)$ Options: (a) 62.51, (b) 3.47, (c) 112, (d) 14.7, (e) 0.183, (f) 113, (g) 10900

(4%) Net thrust: T = _____(lb) Options: (a) 0, (b) 3.29, (c) 11100, (d) 193550, (e) 193410, (f) 10400, (g) 10940

(5%) initial aircraft acceleration: a = _____(ft/sec^2) Options: (a) 0, (b) 8.06, (c) 0.433, (d) 0.456, (e) 14.7, (f) 259, (g) 14.0

4. (Total 25%):

A helicopter starts from rest at point A and travels along the straight-line path with a constant acceleration a. If the speed $v = 36$ m/s when the altitude of the helicopter is $h = 47$ m, determine the values of $\dot{r}$, $\ddot{r}$, $\dot{\theta}$, and $\ddot{\theta}$ as measured by the tracking device at O. At this instant, $\theta = 40°$, and the distance $d = 156$ m. Neglect the small height of the tracking device above the ground.



Within the tracking device software, the default units for tracking values are $m/s, m/s^2, rad/s, rad/s^2$

$\dot{r}$, $\ddot{r}$, $\dot{\theta}$, and $\ddot{\theta}$

(6%) Radial velocity measurement: $\dot{r} =$ _____

(6%) Radial acceleration measurement: $\ddot{r} =$ _____

(6%) Angular velocity measurement: $\dot{\theta} =$ _____

(7%) Angular acceleration measurement: $\ddot{\theta} =$ _____