

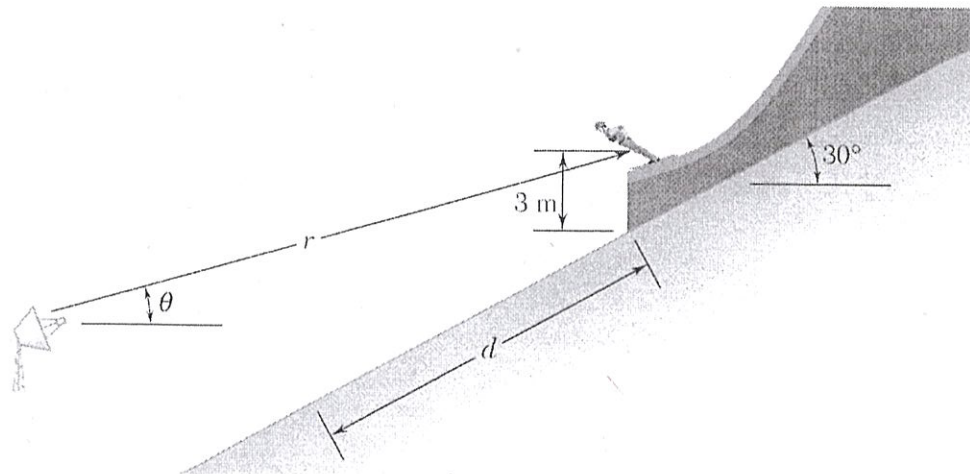
國立臺灣科技大學103學年度碩士班招生試題

系所組別： 自動化及控制研究所碩士班甲組

科 目： 動力學

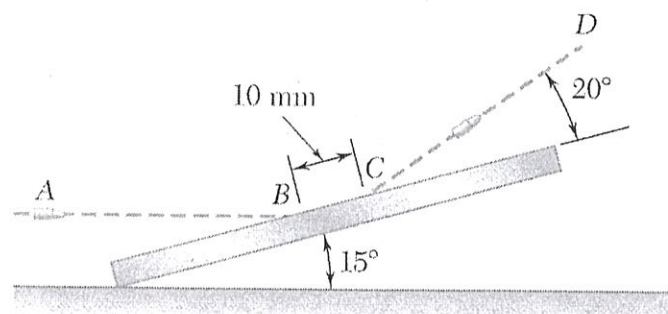
(總分為100分)

1. A telemetry system is used to quantify kinematic values of a ski jumper immediately before she leaves the ramp. According to the system $r = 150$ m, $\dot{r} = -31.5$ m/s, $\ddot{r} = -3$ m/s², $\theta = 25^\circ$, $\dot{\theta} = 0.07$ rad/s, and $\ddot{\theta} = 0.06$ rad/s², determine
- (a) The velocity of the skier immediately before she leaves the jump. (5%)
- (b) The acceleration of the skier at this instant. (10%)
- (c) The distance of the jump d neglecting lift and air resistance. (10%)



Problem 1

2. A 25-g steel-jacketed bullet is fired horizontally with a velocity of 600 m/s and ricochets off a steel plate along the path CD with a velocity of 400 m/s. Knowing that the bullet leaves a 10-mm scratch on the plate and assuming that its average speed is 500 m/s while it is in contact with the plate, determine the magnitude and direction of the average impulsive force exerted by the bullet on the plate. (10%)



Problem 2



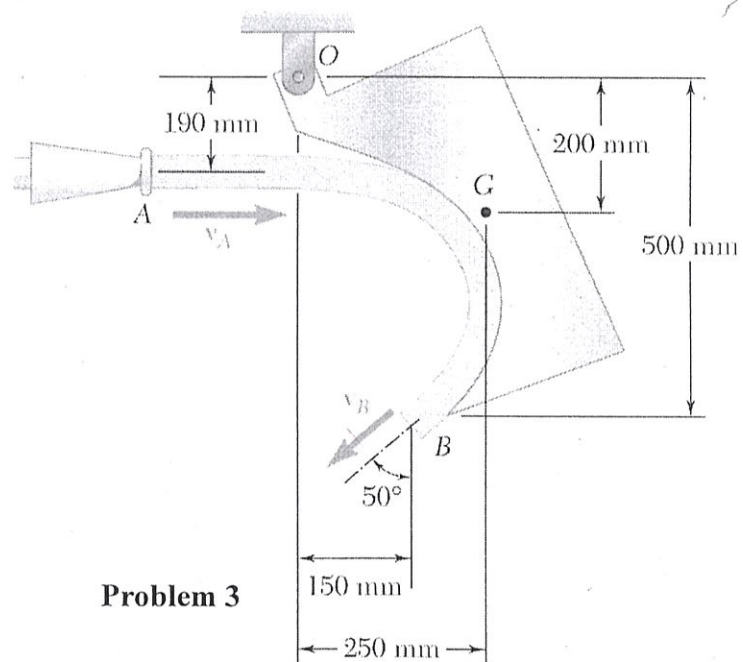
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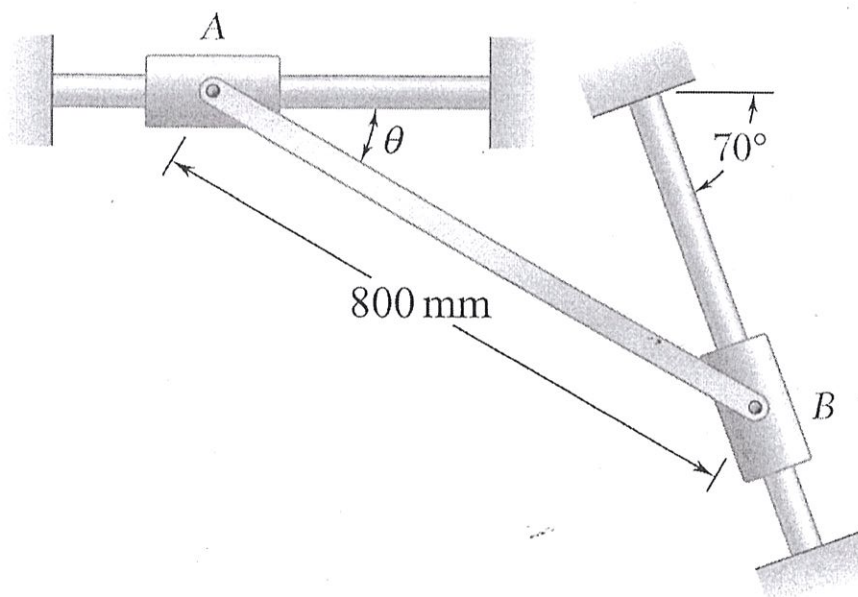
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3. A high-speed jet of air issues from the nozzle A with a velocity of v_A and mass flow rate of 0.36 kg/s . The air impinges on a vane causing it to rotate to the position shown. The vane has a mass of 6-kg . Knowing that the magnitude of the air velocity is equal at A and B , determine
- (a) The magnitude of the velocity at A . (5%)
- (b) The components of the reactions at O . (10%)



4. The 2-kg uniform rod AB is attached to collars of negligible mass which may slide without friction along the fixed rods shown. Rod AB is at rest in the position $\theta = 25^\circ$ when a horizontal force \mathbf{P} is applied to collar A , causing it to start moving to the left with an acceleration of 4 m/s^2 . Determine
- (a) The force \mathbf{P} . (8%)
- (b) The reaction at B . (7%)



Problem 4



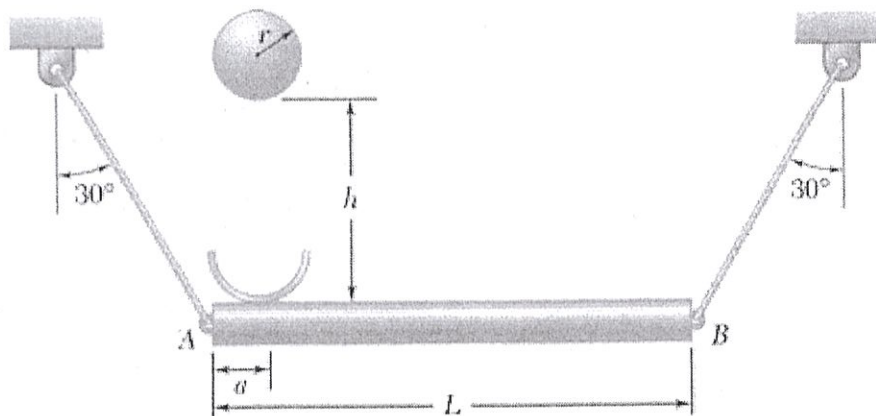
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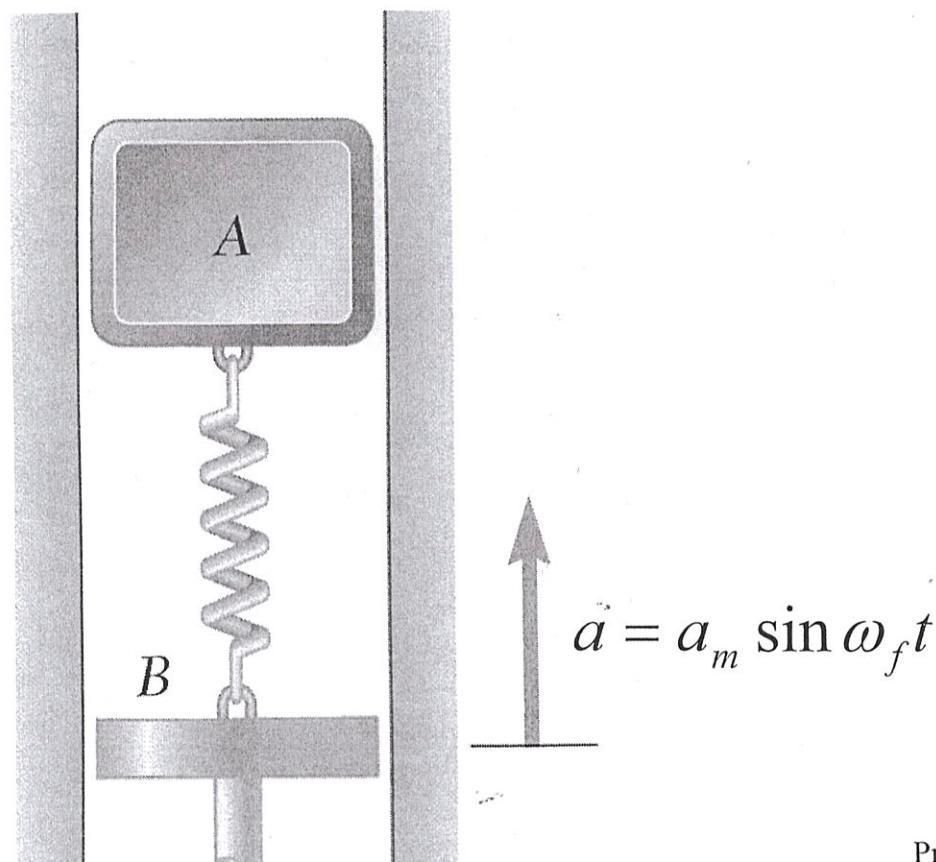
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5. A 2-kg solid sphere of radius $r = 40$ mm is dropped from a height $h = 200$ mm and lands on a uniform slender plank AB of mass 4 kg and length $L = 500$ mm which is held by two inextensible cords. Knowing that the impact is perfectly plastic and that the sphere remains attached to the plank at a distance $a = 40$ mm from the left end, determine the velocity of the sphere immediately after impact. Neglect the thickness of the plank. (20%)



Problem 5

6. An 8-kg block A slides in a vertical frictionless slot and is connected to a moving support B by means of a spring AB of constant $k = 120$ N/m. Knowing that the acceleration of the support is $a = a_m \sin \omega_f t$, where $a_m = 1.5$ m/s² and $\omega_f = 5$ rad/s, determine
- (a) The maximum displacement of block A . (8%)
- (b) The amplitude of the fluctuating force exerted by the spring on the block. (7%)



Problem 6

