※ 考生請注意：本試題 ☑可 □不可 使用計算機

1. (15%) Mary wishes to measure the strength of her biceps muscle by exerting a force on a test strap (Fig. 1). The strap is 28 *cm* from the pivot point at the elbow, and her biceps muscle is attached at a point 5 *cm* from the pivot point. If the scale reads 18 *N* when she exerts her maximum force, what force does the biceps muscle exert?

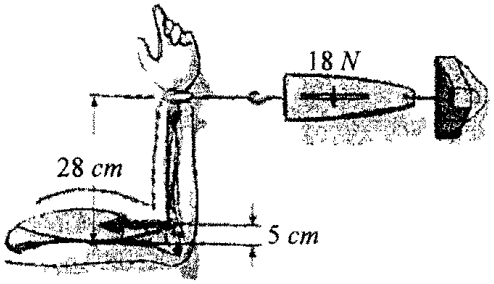

Fig. 1 Analysis of the shoulder joint

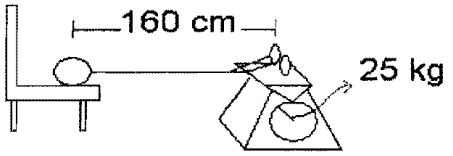

Fig. 2

2. (15%) A man lies rigidly with his head on one chair and his heels on a scale on another chair (Fig. 2). The scale reads 25 kg and the distance from the heels to the back of his head is 160 cm. The weight of the man standing is 70 kg. How far from the heels is the center of gravity?

3. (20%) The slotted fork is rotating about O at the rate θ' which is increasing at θ'' when $\theta = \theta_1$(Fig. 3). Determine the radial and transverse components of the velocity and acceleration of the pin A at this instant. The path is defined by the spiral groove $r = (5 + \theta/\pi)$ *cm*., where θ is in radians. Given: $\theta' = 3$ *rad/s*, $\theta'' = 2$ *rad/s*^{2}, $b = 5$ *cm*, $c = 1/\pi$ *cm*, $\theta_1 = 2\pi$ *rad*

4. (15%) The Raptor is an outside loop roller coaster in which riders are belted into seats resembling ski-lift chairs. Determine the minimum speed v_0 at which the cars should coast down from the top of the hill, so that passengers can just make the loop without leaving contact with their seats. Neglect friction, the size of the car and passenger, and assume each passenger and car has a mass *m*.

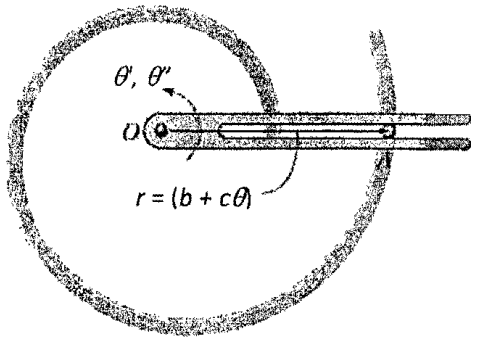

Fig. 3

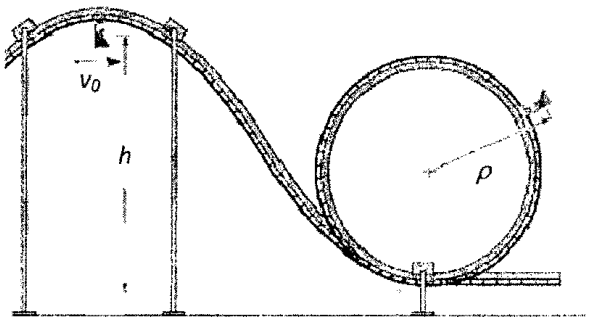

Fig. 4

(背面仍有題目,請繼續作答)

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5 (15%) Determine the moment of inertia of the cone about the z' axis (Fig 5) The weight of the cone is W, the height is h, and the radius is r Given. $W = 15\ kg$, $h = 1.5\ m$, $r = 0.5\ m$

6 (20%) A man kicks the ball of mass M such that it leaves the ground at angle θ with the horizontal and strikes the ground at the same elevation a distance d away Determine the impulse of his foot F on the ball Neglect the impulse caused by the ball's weight while it's being kicked Given $M = 200\ g$, $d = 15\ m$, $\theta = 30\ deg$, gravity=9 8m/s^2

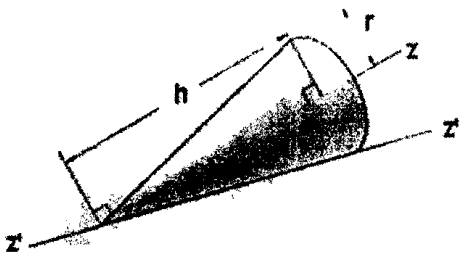

Fig. 5

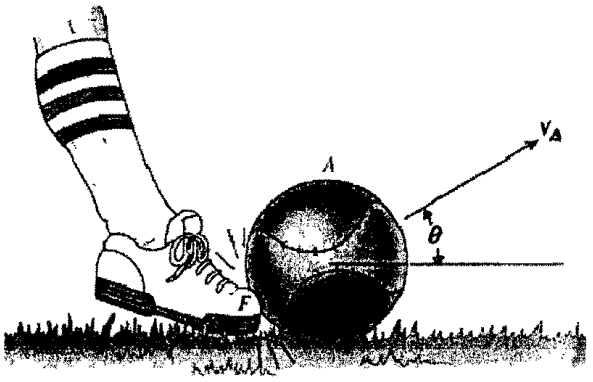

Fig. 6