

本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

1. (25%) A bird of mass m , flying horizontally at speed v_0 perpendicular to a stick, lands on the end of the stick and holds on to it (As shown in Figure 1). The stick with mass M and length L is lying on a frozen pond with negligible friction. Find the angular velocity of the bird and stick as they move together. (Answer in terms of m , M , L , and v_0 . It is known that the moment of inertia of the stick about its center is $ML^2/12$)

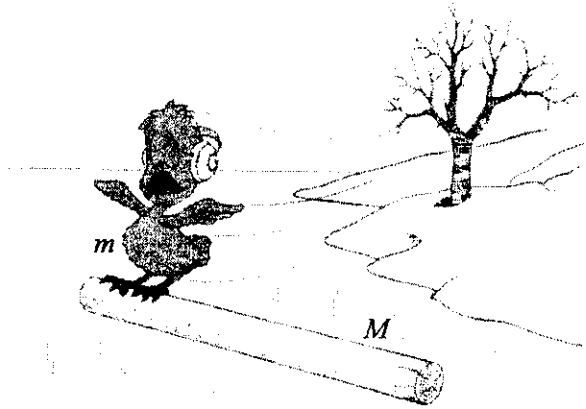


Figure 1

2. (25%) The uniform rod in Figure 2 (length 80cm, mass 20kg) is smoothly pinned to a 50kg cart at point A. Force P , applied to the cart with the system initially at rest, causes the cart to translate with the acceleration $3\leftarrow\text{m/s}^2$. Find the initial angular acceleration of the rod.

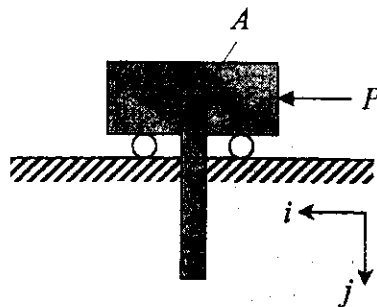


Figure 2

(背面仍有題目, 請繼續作答)

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3. (25%) Translate the following paragraph into Chinese.

Figure 11 shows that the pinion proportion factor is dependent on the actual face width of the gear and on the ratio of the face width to the pitch diameter. Figure 12 relates the mesh alignment factor to expected accuracy of different methods of applying gears. Open gearing refers to drive systems in which the shafts are supported in bearings that are mounted on structure elements of the machine with the expectation that relatively large misalignments will result. In commercial-quality enclosed gear units, the bearings are mounted for which the tolerances on individual dimensions are fairly loose. The precision enclosed gear units are made to tighter tolerances. Extra-precision enclosed gear units are made to exacting precision and are often adjusted at assembly to achieve excellent alignment of the gear teeth.

4. (25%) A fire truck is moving backwards (in the positive y direction) at a constant speed of 5 ft/s. The ladder of the fire truck rotates around the z axis with an angular velocity of $\omega_1 = 0.15$ rad/s, which is increasing at 0.2 rad/s². At the same instant it is rotating upwards at $\omega_2 = 0.6$ rad/s, which is increasing at 0.4 rad/s². At this instant, a fireman at the midpoint B of the ladder is climbing up on the ladder at a constant speed of 3 ft/s. Determine the velocity and acceleration of the fireman. (You must use vector operations, in accordance with the coordinate system shown in the figure, throughout your calculation.)

