題號： 203
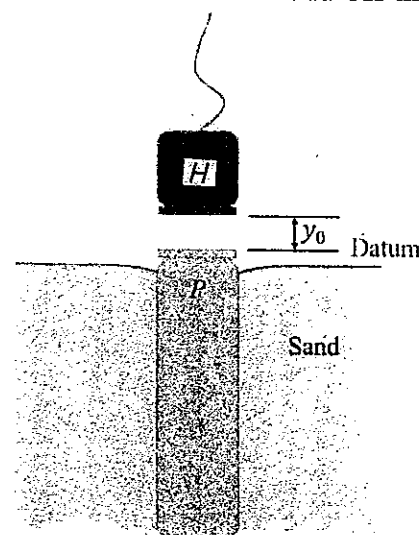科目： 動力學
節次： 7

國立臺灣大學 113 學年度碩士班招生考試試題

題號：203

共 1 頁之第 1 頁

1. This problem consists of two parts. Please provide solutions for both (i) and (ii).

(i) What's the average speed if you ride a bike uphill at 10 km/h and downhill at 20 km/h? (10%)

(ii) A bike starts moving at point A from rest along a circular path of radius r. The bike undergoes acceleration until reaching speed v_c at point C, where the tangential acceleration follows the law $a_t = a_0 (1-kv)$. Determine the acceleration time. Here a_0 is the initial acceleration and k is a constant. (15%)

2. A particle of mass m is subjected to two forces: a central force $\boldsymbol{f}_1 = f(r)\hat{\boldsymbol{r}}$ and a frictional force $\boldsymbol{f}_2 = -\lambda \boldsymbol{v}$, where $\boldsymbol{v}$ is the velocity of the particle, and λ is a positive constant. If the particle initially has angular momentum $\boldsymbol{J}_0$ about the origin at $r = 0$, please find its angular momentum as a function of time. (25%)

3. A chain of total length l, has a mass m, as shown in the figure. Please determine the magnitude of the force **F** required to

(i) raise the chain with a constant speed v_1, starting from rest when y = 0 (13%);

(ii) lower the chain with a constant speed v_2, starting from rest when y = l. (12%)
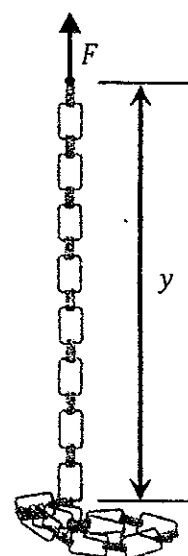
4. A rigid pile of mass M is driven into the ground using a hammer of mass m. The hammer falls from rest at a height y_0 and strikes the top of the pile, as shown in the figure. Determine the impulse which the pile exerts on the hammer if the pile is surrounded entirely by loose sand so that after striking, the hammer does not rebound off the pile. (25%)

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