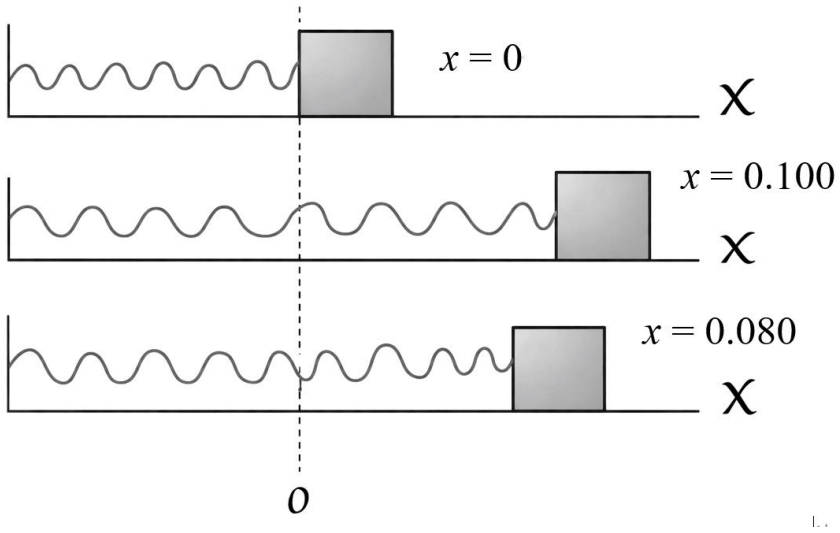
# 中央警察大學 115 學年度碩士班入學考試試題

所　別：鑑識科學研究所
科　目：自然科學

作答注意事項：

1.本試題共 10 題，每題各占 10 分；共 4 頁。
2.不用抄題，可不按題目次序作答，但應書寫題號。
3.禁用鉛筆作答，違者不予計分。

一、The figure below shows a block with mass $m$ = 0.400 kg sits on a frictionless air track, connected to a spring with force constant $k$ = 10.00 N/m (equilibrium position, $x$ = 0). You pull on the block, stretching the spring 0.100 m ($x$ = 0.100), and release it from rest. The block moves back toward its equilibrium position. What is its $x$-velocity when $x$ = 0.080 m?

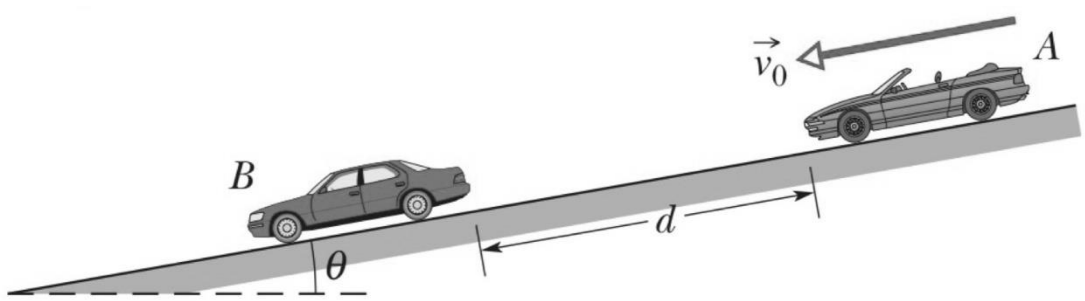



【Hint】:

1. Hooke's law: $F_x = -kx$ .

2. Work by a spring force: $W_{s=}\frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$ .

二、The figure below shows an accident. Car A slid into the rear of car B, which was stopped at a red light along a road headed down a hill. The slope of the hill is $\theta = 12°$. The cars were separated by distance $d = 24.0$ m when the driver of car A put the car into a slide (it lacked any automatic anti-brake-lock system), and that the speed of car A at the onset of braking was $v_0 = 18.0$ m/s. With what speed did car A hit car B if the coefficient of kinetic friction was 0.60?




【Hint】:

1. the magnitude of the free-fall acceleration $g$ = 9.8 m/s$^2$.

2. $\sin 12° \approx 0.20$ ; $\cos 12° \approx 0.98$ .

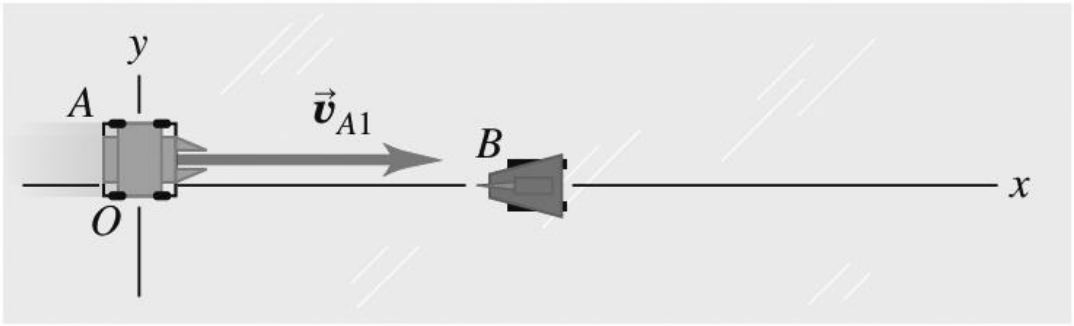
3. $v = v_0 + at$ .

4. $S = v_0 t + \frac{1}{2} a t^2$ .

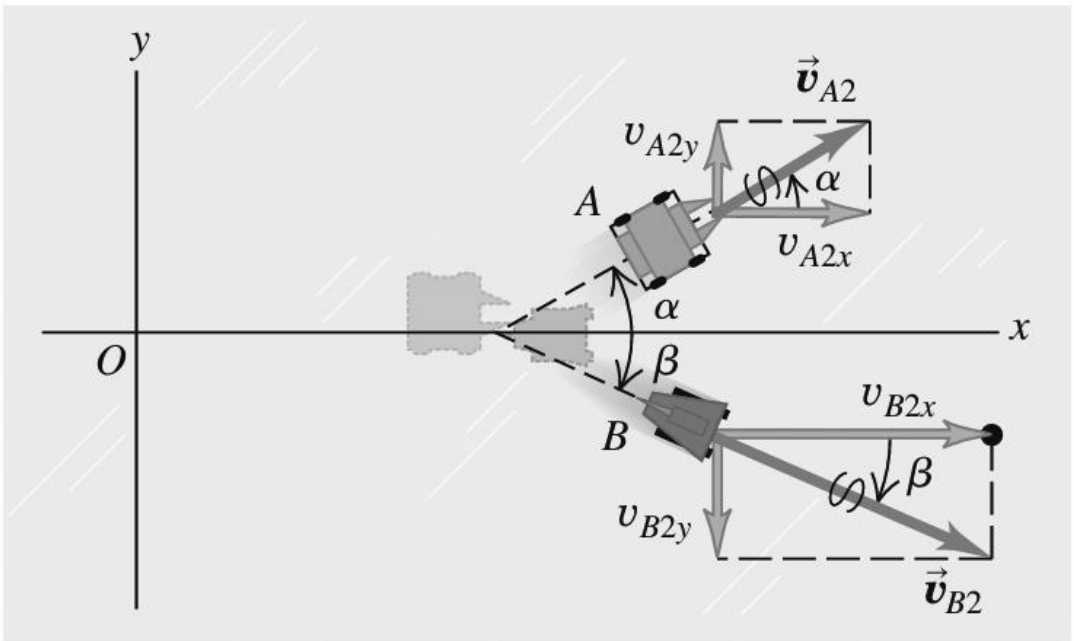
5. $v^2 = {v_0}^2 + 2aS$ .

三、The figure below shows two toy cars on a frictionless surface. Car A, with mass 30 kg, initially moves at 2.0 m/s parallel to the *x*-axis. It collides with car B, which has mass 15 kg and is initially at rest. After the collision, car A moves at 1.0 m/s in a direction that makes an angle $\alpha = 30^{o}$ with its initial direction. What is the final velocity of car B?

(a) Before collision




(b) After collision




四、Use a Punnett square to predict the offspring in a cross between (a) a dwarf pea plant (homozygous recessive) and a tall pea plant (heterozygous). What is the phenotypic ratio of the offspring? (b) a tall pea plant (heterozygous) and a tall pea plant (heterozygous). What is the genotypic ratio of the offspring?

五、When a student mixes 50 mL of 1.0 *M* (= 1.0 mol/L) HCL and 50 mL of 1.0 *M* NaOH in a coffee-cup calorimeter, the temperature of the resultant solution increases from 21.0℃ to 27.5℃ . Calculate the enthalpy change for the reaction in kJ/mol HCl, assuming that the calorimeter loses only a negligible quantity of heat, that the total volume of the solution is 100 mL, that its density is 1.0 g/mL, and that its specific heat is 4.18 J/g-K.

六、說明以 DNA 選殖（DNA cloning）技術，獲得可以生產人類生長因子（growth hormone, GH）轉殖細菌（transgenic bacteria）之流程。並說明如何有效的篩選出可以產生該生長因子的菌落（colony）？

七、說明孟德爾如何進行豌豆之雙性狀雜交（dihybrid cross）？根據實驗結果，提出何種理論？若進行 4 性狀雜交（tetra-hybrid cross），F2 世代分別可獲得多少種基因型（genotype）及表現型（phenotype）的組合？

八、請繪出以下 5 種化合物之結構：

（一）2-hexanone

（二）pentanoic acid

（三）acetamide

（四）*t*-butyl alcohol

（五）octanal

九、請說明放射性元素之衰變有哪幾種類型？

十、請簡述克卜勒之行星運動三大定律（Kepler's Laws of Planetary Motion）。