※ 考生請注意：本試題不可使用計算機

1. Please find the derivate of the following functions. (20%)

　　(1) $y = 2\cot^2(\pi x + 2)$　　　　(2) $y = 5^{\sqrt{x}}$　　　(3) $y = \ln\left(\sqrt{\dfrac{e^x+1}{e^x-1}}\right), x > 0$

　　(4) $y = \log_5 \dfrac{x\sqrt{x-1}}{2}$

2. Please determine the limit for the following functions. (15%)

　　(1) $\lim\limits_{x\to 0} \dfrac{\cos x - 1}{2x^2}$　　(2) $\lim\limits_{x\to 0} \dfrac{a^x - a^{\tan x}}{x^3}$　　(3) $\lim\limits_{x\to\infty}(x - \sqrt{x^2+x})$

3. As shown in the Figure 1, rainbows are formed when light beam strikes raindrops and is reflected (at point B) and refracted (at points A and C). The law of refraction states that $(\sin\alpha/\sin\beta) = k$. The angle of deflection is given by $D = \pi + 2\alpha - 4\beta$. Let $D' = \dfrac{dD}{d\alpha}, \ 0 \le \alpha \le \dfrac{\pi}{2}$. Please find the minimum angle of deflection (represents as k). (15%)
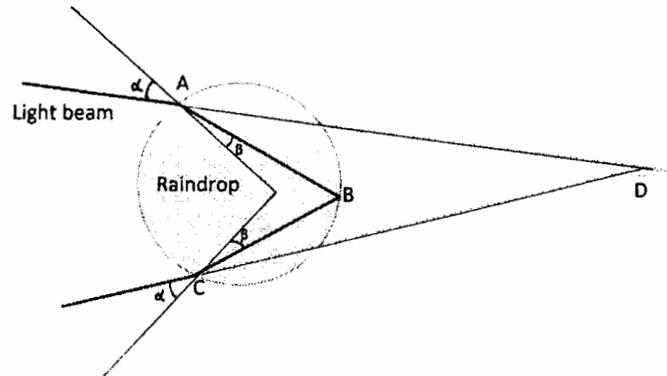

Figure 1

4. Please evaluate the integral of the following functions. (25%)

　　(1) $\int (x+1)\sqrt{2-x}\,dx$　　　(2) $\int \dfrac{1}{\sin^3 x}\,dx$　　　(3) $\int \dfrac{x^2+1}{x(x+1)^3}\,dx$

　　(4) $\int xe^x \sin x\,dx$　　　　　(5) $\int_0^{\pi/2}\int_0^3 re^{-r^2}\,dr\,d\theta$

(背面仍有題目,請繼續作答)

系所組別：環境工程學系丙組

考試科目：微積分　　　　　　　　　　　　　　　　考試日期：0223，節次：3

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5. Water is flowing through a channel which has a cross-section in the shape of isosceles trapezoid, as shown in Figure 2. If the two legs and bottom have the same length 1. Please find the maximum cross-sectional area. (15%)
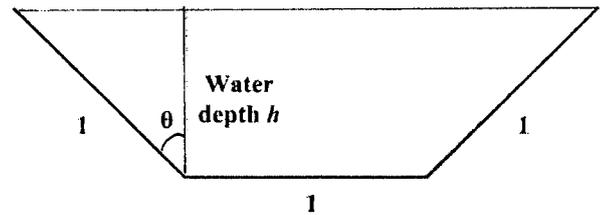

Figure 2

6. Please use a line integral to find the area of an ellipse: $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1.$ (10%)

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