(1)-(10)題各 8 分，按題序標清題號寫下答案，其他計算式一律不予計分。

1. A car is racing along the elliptical route $x^2/9 + y^2/16 = 2500\text{m}^2$. When the car is at the point $(120\text{m}, 120\text{m})$, a man at the point $(30\text{m}, 0)$ determines with radar that the distance between him and the car is increasing at the rate 37m/sec. Find the speed (m/sec) of the car at that moment.

2. Find $\lim_{x\to 0}\left(\frac{x}{\sin^3 x} - \frac{1}{x^2}\right)$.

3. Given $f(x) = \ln(1 + x + x^2)$, find $f^{(3k)}(0)$, where $k \geq 0$ is an integer .

4. Find the arc length of the curve $y = x^2/2$ from $x = 0$ to $x = 1$.

5. Find the volume of the solid generated by revolving the region enclosed by the curve $y = \frac{2x}{4 - x^2}$, the x-axis, $x = 0$ and $x = 1$.

6. Let $g(x)$ be the inverse function of $f(x) = x(\ln x)^3$ for $x \geq 1$. Find $\int_0^e g(x)dx$.

7. Find the tangent plane to the surface $x^3 + y^3 + z^3 - 3xy^2z^3 = 0$ at the point $x = 1$, $y = 1$ and $z = 1$.

8. Find the local minimum values of $f(x, y) = x^3 - 12xy + 8y^3$.

9. Evaluate $\int_{y=0}^{y=2}\int_{x=y}^{x=2} e^{x^2}dxdy$.

10. Solve the differential equation $y'\cos x + y\sin x = \cos^3 x$, $y(\pi/4) = 1$.

(A)、(B)兩題各 10 分，請寫出詳盡之計算與論證過程。

A. Evaluate $\iint_\Omega \sqrt{x^2 + xy + y^2}dxdy$, where $\Omega = \{(x, y) : x^2 + xy + y^2 \leq 1\}$, by first making the change of variables $u = x + \frac{y}{2}$, $v = \frac{\sqrt{3}y}{2}$ and then by polar coordinates.

B. Let Γ be the intersection curve of the two surfaces $x^3 + 2y^3 + 3z^3 - 2xyz = 4$ and $x^2 + y^2 + z^2 = 3$. Find the unit tangent vector to Γ at the point $(1, 1, 1)$

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