*** 務必寫出計算過程，否則不予計分。 ***

1. (10%) Find the derivative of the function, if

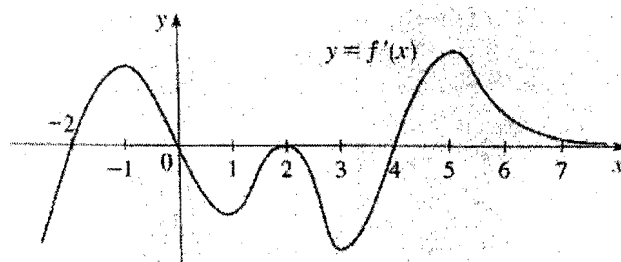   (1) $f(x) = (x + \dfrac{1}{x^2})^{\sqrt{7}}$.

   (2) $f(x) = \displaystyle\int_1^{\cos x} \sqrt[3]{1 - t^2}\, dt$

2. (15%) The following figure shows the graph of the derivative f' of a function f.

   (1) On what interval is f increasing?

   (2) For what value of x does f have a local maximum or minimum?

   (3) Sketch the graph of f''.

3. (5%) Find an equation of the tangent plane to the surface $z = 3y^2 - 2x^2 + x$ at the point $(2, -1, -3)$.

4. (15 %) Find the local maximum and minimum values and saddle points of

   $f(x, y) = x^4 + y^4 - 4xy + 1$.

5. (20%) Evaluate the integral.

   (1) $\displaystyle\int_1^2 x\sqrt{x - 1}\, dx$

   (2) $\displaystyle\int \frac{1}{x^2\sqrt{x^2 + 4}}\, dx$

6. (10%) Find the Maclaurin series for the function $f(x) = \dfrac{1}{\sqrt{4 - x}}$ and its radius of convergence.

7. (10%) Find the points on the sphere $x^2 + y^2 + z^2 = 4$ that are closest to and farthest from the point $(3, 1, -1)$.

8. (5%) Evaluate $\displaystyle\iint_R y\sin(xy)\, dA$, where R = $[1, 2] \times [0, \pi]$.

9. (10%) Use polar coordinates to find the volume of the solid that lies under the cone

   $z = \sqrt{x^2 + y^2}$ and above the disk $x^2 + y^2 \le 4$.