【DSE M2 公式表：按課題整理的全部公式】DSE M2 Formula Sheet: Every Formula by Topic

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> 本頁按課題整理 DSE M2 課程要求掌握的公式。每個標題均連結至該課題的完整筆記，附例題詳解及互動圖像。This page collects the formulas the DSE M2 curriculum expects you to know, grouped by topic. Each heading links to the full notes for that topic, with worked examples and an interactive graph.

問某條公式如何運用 Ask how to use a formula

怎樣選公式？兩個例題 Choose a Formula: Two Worked Examples

求 y = sin(3x) 的導數。x 以弧度量度時，使用連鎖法則：dy/dx = cos(3x) × 3 = **3cos(3x)**。只寫 cos(3x) 便漏了內函數的導數 3；標準三角函數求導公式假設角以弧度量度。

求 a = (1, 2, 2) 與 b = (2, 0, 1) 的夾角。未知數是角，選純量積：a · b = 4，|a| = 3，|b| = √5。因此 cos θ = 4/(3√5)，得 θ ≈ **53.4°**。若題目改問平行四邊形面積，則選 |a × b| = √29。先看所求，才選公式。

以下各課題連結提供完整方法及更多例題。以上是原創溫習例題，並非轉載考評局試題。

Differentiate y = sin(3x). With x measured in radians, use the chain rule: dy/dx = cos(3x) × 3 = **3cos(3x)**. The inner derivative matters: cos(3x) alone misses a factor of 3. The standard trigonometric derivative formulas assume radians.

Find the angle between a = (1, 2, 2) and b = (2, 0, 1). Choose the dot product because the unknown is an angle: a · b = 4, |a| = 3 and |b| = √5. Thus cos θ = 4/(3√5), so θ ≈ **53.4°**. For the area of the parallelogram instead, choose |a × b| = √29. The question decides which product to use.

Use the topic links below for the full methods and more examples. These are original revision examples, not reproduced HKEAA questions.

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三角公式 Trigonometry Formulas

- π rad = 180°；$1 + \tan^2\theta = \sec^2\theta$；$1 + \cot^2\theta = \operatorname{cosec}^2\theta$
- $\sin(A \pm B) = \sin A\cos B \pm \cos A\sin B$
- $\cos(A \pm B) = \cos A\cos B \mp \sin A\sin B$
- $\tan(A \pm B) = (\tan A \pm \tan B)\,/\,(1 \mp \tan A\tan B)$
- $\sin 2A = 2\sin A\cos A$；$\cos 2A = \cos^2 A - \sin^2 A = 1 - 2\sin^2 A = 2\cos^2 A - 1$；$\tan 2A = 2\tan A\,/\,(1 - \tan^2 A)$
- $\sin^2 A = \frac{1}{2}(1 - \cos 2A)$；$\cos^2 A = \frac{1}{2}(1 + \cos 2A)$
- $2\sin A\cos B = \sin(A + B) + \sin(A - B)$；$2\cos A\cos B = \cos(A + B) + \cos(A - B)$；$2\sin A\sin B = \cos(A - B) - \cos(A + B)$
- $\sin A + \sin B = 2\sin\frac{(A + B)}{2}\cos\frac{(A - B)}{2}$；$\sin A - \sin B = 2\cos\frac{(A + B)}{2}\sin\frac{(A - B)}{2}$
- $\cos A + \cos B = 2\cos\frac{(A + B)}{2}\cos\frac{(A - B)}{2}$；$\cos A - \cos B = -2\sin\frac{(A + B)}{2}\sin\frac{(A - B)}{2}$

筆記：M2 三角學 →

- π rad = 180°; $1 + \tan^2\theta = \sec^2\theta$; $1 + \cot^2\theta = \operatorname{cosec}^2\theta$
- $\sin(A \pm B) = \sin A\cos B \pm \cos A\sin B$
- $\cos(A \pm B) = \cos A\cos B \mp \sin A\sin B$
- $\tan(A \pm B) = (\tan A \pm \tan B)\,/\,(1 \mp \tan A\tan B)$
- $\sin 2A = 2\sin A\cos A$; $\cos 2A = \cos^2 A - \sin^2 A = 1 - 2\sin^2 A = 2\cos^2 A - 1$; $\tan 2A = 2\tan A\,/\,(1 - \tan^2 A)$
- $\sin^2 A = \frac{1}{2}(1 - \cos 2A)$; $\cos^2 A = \frac{1}{2}(1 + \cos 2A)$
- $2\sin A\cos B = \sin(A + B) + \sin(A - B)$; $2\cos A\cos B = \cos(A + B) + \cos(A - B)$; $2\sin A\sin B = \cos(A - B) - \cos(A + B)$
- $\sin A + \sin B = 2\sin\frac{(A + B)}{2}\cos\frac{(A - B)}{2}$; $\sin A - \sin B = 2\cos\frac{(A + B)}{2}\sin\frac{(A - B)}{2}$
- $\cos A + \cos B = 2\cos\frac{(A + B)}{2}\cos\frac{(A - B)}{2}$; $\cos A - \cos B = -2\sin\frac{(A + B)}{2}\sin\frac{(A - B)}{2}$

Notes: trigonometry in M2 →

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二項式定理、e 及極限 Binomial Theorem, e and Limits

- $(a + b)^n = \Sigma\, C(n, r)\, a^{n-r}\, b^r$；通項 $T_{r+1} = C(n, r)\, a^{n-r}\, b^r$
- $e = \lim_{n\to\infty}(1 + 1/n)^n$；$e^x = 1 + x + x^2/2! + x^3/3! + \cdots$
- $\lim_{\theta\to 0}(\sin\theta)/\theta = 1$；$\lim_{x\to 0}(e^x - 1)/x = 1$

二項式定理 → · 極限 →

- $(a + b)^n = \Sigma\ C(n, r)\ a^{n-r}\ b^r$；general term $T_{r+1} = C(n, r)\ a^{n-r}\ b^r$
- $e = \lim_{n\to\infty} (1 + 1/n)^n$；$e^x = 1 + x + x^2/2! + x^3/3! + \dots$
- $\lim_{\theta\to 0} (\sin\theta)/\theta = 1$；$\lim_{x\to 0} (e^x - 1)/x = 1$

Binomial theorem → · Limits →

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求導公式 Differentiation Formulas

- $f'(x) = \lim_{h\to 0} [f(x + h) - f(x)] / h$
- $(x^n)' = nx^{n-1}$；$(\sin x)' = \cos x$；$(\cos x)' = -\sin x$；$(\tan x)' = \sec^2 x$；$(e^x)' = e^x$；$(\ln x)' = 1/x$
- $(uv)' = u'v + uv'$；$(u/v)' = (u'v - uv')/v^2$；$dy/dx = (dy/du)(du/dx)$
- 切線：$y - f(x_0) = f'(x_0)(x - x_0)$

求導法 → · 求導法的應用 →

- $f'(x) = \lim_{h\to 0} [f(x + h) - f(x)] / h$
- $(x^n)' = nx^{n-1}$; $(\sin x)' = \cos x$; $(\cos x)' = -\sin x$; $(\tan x)' = \sec^2 x$; $(e^x)' = e^x$; $(\ln x)' = 1/x$
- $(uv)' = u'v + uv'$; $(u/v)' = (u'v - uv')/v^2$; $dy/dx = (dy/du)(du/dx)$
- Tangent: $y - f(x_0) = f'(x_0)(x - x_0)$

Differentiation → · Applications →

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積分公式 Integration Formulas

- $\int x^n\ dx = x^{n+1}/(n + 1) + C$（$n \neq -1$）；$\int (1/x)\ dx = \ln|x| + C$；$\int e^x\ dx = e^x + C$
- $\int \sin x\ dx = -\cos x + C$；$\int \cos x\ dx = \sin x + C$；$\int \sec^2 x\ dx = \tan x + C$
- $\int u\ dv = uv - \int v\ du$
- $\int_{-a}^{a} f(x)\ dx = 0$（奇函數）；$= 2\int_0^a f(x)\ dx$（偶函數）
- 曲線間面積：$\int_a^b [f(x) - g(x)]\ dx$
- 繞 x 軸的體積：$\pi\int_a^b y^2\ dx$；繞 y 軸：$\pi\int_c^d x^2\ dy$

不定積分法 → · 用哪種方法？→ · 面積及體積 →

- $\int x^n\,dx = x^{n+1}/(n+1) + C\ (n \neq -1)$; $\int (1/x)\,dx = \ln|x| + C$; $\int e^x\,dx = e^x + C$
- $\int \sin x\,dx = -\cos x + C$; $\int \cos x\,dx = \sin x + C$; $\int \sec^2 x\,dx = \tan x + C$
- $\int u\,dv = uv - \int v\,du$
- $\int_{-a}^{a} f(x)\,dx = 0$ (odd); $= 2\int_0^a f(x)\,dx$ (even)
- Area between curves: $\int_a^b [f(x) - g(x)]\,dx$
- Volume about the x-axis: $\pi\int_a^b y^2\,dx$; about the y-axis: $\pi\int_c^d x^2\,dy$

Indefinite integration → · Which method? → · Area and volume →

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矩陣、行列式及線性方程組 Matrices, Determinants and Linear Systems

- $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$；三階行列式按行展開，正負號為 + − +
- $A^{-1} = (1/|A|)\,\text{adj}\,A$；$[a\ b;\ c\ d]^{-1} = (1/(ad-bc))\,[d\ -b;\ -c\ a]$
- $(AB)^{-1} = B^{-1}A^{-1}$；$|AB| = |A||B|$；$(A^{\mathsf{T}})^{-1} = (A^{-1})^{\mathsf{T}}$
- 克萊瑪法則：當 $\Delta \neq 0$，$x = \Delta_x/\Delta$、$y = \Delta_y/\Delta$、$z = \Delta_z/\Delta$
- 齊次方程組：有非零解 $\iff |A| = 0$

矩陣 → · 線性方程組 →

- $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$; order 3 by expansion along a row with signs + − +
- $A^{-1} = (1/|A|)\,\text{adj}\,A$; $[a\ b;\ c\ d]^{-1} = (1/(ad-bc))\,[d\ -b;\ -c\ a]$
- $(AB)^{-1} = B^{-1}A^{-1}$; $|AB| = |A||B|$; $(A^{\mathsf{T}})^{-1} = (A^{-1})^{\mathsf{T}}$
- Cramer's rule: $x = \Delta_x/\Delta$, $y = \Delta_y/\Delta$, $z = \Delta_z/\Delta$ when $\Delta \neq 0$
- Homogeneous system: non-trivial solutions $\iff |A| = 0$

Matrices → · Linear systems →

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向量公式 Vector Formulas

- $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$；$|x\mathbf{i} + y\mathbf{j} + z\mathbf{k}| = \sqrt{x^2 + y^2 + z^2}$
- $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos\theta = a_1b_1 + a_2b_2 + a_3b_3$
- $\mathbf{a} \times \mathbf{b} = (a_2b_3 - a_3b_2)\mathbf{i} - (a_1b_3 - a_3b_1)\mathbf{j} + (a_1b_2 - a_2b_1)\mathbf{k}$；$|\mathbf{a} \times \mathbf{b}| = |\mathbf{a}||\mathbf{b}| \sin\theta$
- $\mathbf{b}$ 在 $\mathbf{a}$ 上的投影：$((\mathbf{a} \cdot \mathbf{b})/|\mathbf{a}|^2)\mathbf{a}$

- 三角形面積：$\frac{1}{2}|\overrightarrow{AB} \times \overrightarrow{AC}|$；分點公式：$\overrightarrow{OP} = (n\mathbf{a} + m\mathbf{b})/(m + n)$

純量積與向量積 → · 向量的應用 →

- $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$; $|x\mathbf{i} + y\mathbf{j} + z\mathbf{k}| = \sqrt{(x^2 + y^2 + z^2)}$
- $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos\theta = a_1b_1 + a_2b_2 + a_3b_3$
- $\mathbf{a} \times \mathbf{b} = (a_2b_3 - a_3b_2)\mathbf{i} - (a_1b_3 - a_3b_1)\mathbf{j} + (a_1b_2 - a_2b_1)\mathbf{k}$; $|\mathbf{a} \times \mathbf{b}| = |\mathbf{a}||\mathbf{b}| \sin\theta$
- Projection of $\mathbf{b}$ onto $\mathbf{a}$: $((\mathbf{a} \cdot \mathbf{b})/|\mathbf{a}|^2)\mathbf{a}$
- Area of triangle: $\frac{1}{2}|\overrightarrow{AB} \times \overrightarrow{AC}|$; section formula: $\overrightarrow{OP} = (n\mathbf{a} + m\mathbf{b})/(m + n)$

Dot and cross product → · Applications of vectors →

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常見問題 Frequently Asked Questions

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不定積分法 Indefinite Integration

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