



Ember

EDUCATION

MF27

H2 MATHEMATICS

WHATSAPP 88640447

ember-education.com

Hate Maths?

*More specifically,
Vectors?*

~~ME TOO~~

Ember makes it tolerable.

An ember is the quiet, glowing piece of charcoal at a fireplace. Not yet a flame, but ready to catch fire. That is the vision of Ember Education for every student who walks through our doors.

One class. One school. One pace.

Every JC follows the same H2 syllabus, but the order, pacing, and exam calendar at your school is nothing like the JC just a few MRT stops away. **Tuition centres that squeeze students from all JCs try to please everyone but end up syncing with no one.**

The advantage of Ember Education: **a class dedicated to your pace and your learning.**

Built around your school's calendar.

When your school is three weeks out from a test, **the whole class is three weeks out.** We revise and drill the topics your school is testing, on the schedule your school is testing them. No more sitting through revision for content your school hasn't covered yet, or rushing past topics your school is still on.

Curated notes and questions.

Do you wish your notes went **straight to the point** more often? Our materials are handcrafted to **strip what's unnecessary**, leaving only what matters. Questions are curated to broaden exposure and **sharpen the instincts needed to score**. We build a strong foundation first, then layer upwards, without rushing.

Easy to reach, whenever you need us.

Currently located a short walk from **Jurong East MRT**, **Mayflower MRT**, and **Kovan MRT**. More classrooms opening up around Singapore. Contact us today.



Come in for a free trial lesson, and see what learning at your school's pace feels like.

Fees & Referral

Fees

Year 1	\$340 / month
Year 2	\$350 / month
Year 3	\$360 / month

First 50 sign-ups get 20% off their first month.

Taking 2 or more subjects? \$50 off your second subject.

Referral Programme

Know a friend who hates Maths too? Refer them.

1 st referral	\$88 cash
2 nd referral	\$108 cash
3 rd referral	\$138 cash
4 th referral	\$188 cash
5 th referral	\$288 cash

Your referred friend also gets 20% off their first month (first 50 sign-ups only).

Come in for a free trial lesson, and see what learning on your terms feels like.

Algebraic Series

Binomial expansion

$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \binom{n}{3}a^{n-3}b^3 + \dots + b^n$, where n is a positive integer

$$\text{and } \binom{n}{r} = \frac{n!}{r!(n-r)!}$$

Maclaurin expansion

$$f(x) = f(0) + x f'(0) + \frac{x^2}{2!} f''(0) + \dots + \frac{x^n}{n!} f^{(n)}(0) + \dots$$

$$(1 + x)^n = 1 + nx + \frac{n(n-1)}{2!} x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{r!} x^r + \dots \quad (|x| < 1)$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots + \frac{x^r}{r!} + \dots \quad (\text{all } x)$$

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots + \frac{(-1)^r x^{2r+1}}{(2r+1)!} + \dots \quad (\text{all } x)$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots + \frac{(-1)^r x^{2r}}{(2r)!} + \dots \quad (\text{all } x)$$

$$\ln(1 + x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \dots + \frac{(-1)^{r+1} x^r}{r} + \dots \quad (-1 < x \leq 1)$$

Partial Fractions Decomposition

Non-repeated linear factors:

$$\frac{px + q}{(ax + b)(cx + d)} = \frac{A}{ax + b} + \frac{B}{cx + d}$$

Repeated linear factors:

$$\frac{px^2 + qx + r}{(ax + b)(cx + d)^2} = \frac{A}{ax + b} + \frac{B}{cx + d} + \frac{C}{(cx + d)^2}$$

Non-repeated quadratic factor:

$$\frac{px^2 + qx + r}{(ax + b)(x^2 + c^2)} = \frac{A}{ax + b} + \frac{Bx + C}{x^2 + c^2}$$

Trigonometry

$$\sin(A \pm B) \equiv \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) \equiv \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) \equiv \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A \equiv 2 \sin A \cos A$$

$$\cos 2A \equiv \cos^2 A - \sin^2 A \equiv 2 \cos^2 A - 1 \equiv 1 - 2 \sin^2 A$$

$$\tan 2A \equiv \frac{2 \tan A}{1 - \tan^2 A}$$

Principal values

$$-\frac{1}{2}\pi \leq \sin^{-1}x \leq \frac{1}{2}\pi \quad (|x| \leq 1) \quad 0 \leq \cos^{-1}x \leq \pi \quad (|x| \leq 1) \quad -\frac{1}{2}\pi < \tan^{-1}x < \frac{1}{2}\pi$$

Derivatives

$f(x)$	$f'(x)$
$\sin^{-1} x$	$\frac{1}{\sqrt{1-x^2}}$
$\cos^{-1} x$	$-\frac{1}{\sqrt{1-x^2}}$
$\tan^{-1} x$	$\frac{1}{1+x^2}$
$\operatorname{cosec} x$	$-\operatorname{cosec} x \cot x$
$\sec x$	$\sec x \tan x$

Integrals

Arbitrary constants are omitted; a denotes a positive constant.

$f(x)$	$\int f(x) dx$	
$\frac{1}{x^2 + a^2}$	$\frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right)$	
$\frac{1}{\sqrt{a^2 - x^2}}$	$\sin^{-1}\left(\frac{x}{a}\right)$	$ x < a$
$\frac{1}{x^2 - a^2}$	$\frac{1}{2a} \ln \left \frac{x-a}{x+a} \right $	$x > a$
$\frac{1}{a^2 - x^2}$	$\frac{1}{2a} \ln \left \frac{a+x}{a-x} \right $	$ x < a$
$\tan x$	$\ln(\sec x)$	$ x < \frac{1}{2}\pi$
$\cot x$	$\ln(\sin x)$	$0 < x < \pi$
$\operatorname{cosec} x$	$-\ln(\operatorname{cosec} x + \cot x)$	$0 < x < \pi$
$\sec x$	$\ln(\sec x + \tan x)$	$ x < \frac{1}{2}\pi$

Vectors

The point dividing AB in the ratio $\lambda : \mu$ has position vector $\frac{\mu \mathbf{a} + \lambda \mathbf{b}}{\lambda + \mu}$.

Vector product

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} \times \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix} = \begin{pmatrix} a_2 b_3 - a_3 b_2 \\ a_3 b_1 - a_1 b_3 \\ a_1 b_2 - a_2 b_1 \end{pmatrix}$$

Applications of Definite Integrals

Arc length of a curve defined in Cartesian form:

$$\int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx$$

Surface area of revolution about the x -axis for a curve defined in Cartesian form:

$$\int_a^b 2\pi y \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx$$

Functions of Two Variables

Quadratic approximation of f at (a, b) :

$$f(x, y) \approx f(a, b) + f_x(a, b)(x - a) + f_y(a, b)(y - b) \\ + \frac{1}{2}f_{xx}(a, b)(x - a)^2 + f_{xy}(a, b)(x - a)(y - b) + \frac{1}{2}f_{yy}(a, b)(y - b)^2$$

Numerical Methods

Trapezium rule (for single strip):

$$\int_a^b f(x) \, dx \approx \frac{1}{2}(b - a)[f(a) + f(b)]$$

Simpson's rule (for two strips):

$$\int_a^b f(x) \, dx \approx \frac{1}{6}(b - a) \left[f(a) + 4f\left(\frac{a+b}{2}\right) + f(b) \right]$$

The Newton-Raphson iteration for approximating a root of $f(x) = 0$:

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)}$$

where x_1 is a first approximation.

Euler method with step size h

$$y_2 = y_1 + h f(x_1, y_1)$$

Improved Euler method with step size h

$$u_2 = y_1 + h f(x_1, y_1) \\ y_2 = y_1 + \frac{h}{2} [f(x_1, y_1) + f(x_2, u_2)]$$

Standard Discrete Distributions

Distribution of X	$P(X = x)$	Mean	Variance
Binomial $B(n, p)$	$\binom{n}{x} p^x (1-p)^{n-x}$	np	$np(1-p)$
Poisson $Po(\lambda)$	$e^{-\lambda} \frac{\lambda^x}{x!}$	λ	λ
Geometric $Geo(p)$	$(1-p)^{x-1} p$	$\frac{1}{p}$	$\frac{1-p}{p^2}$

Standard Continuous Distribution

Distribution of X	p.d.f.	Mean	Variance
Exponential	$\lambda e^{-\lambda x}$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$

Sampling and Testing

Unbiased estimate of population variance

$$s^2 = \frac{1}{n-1} \left[\sum x^2 - \frac{(\sum x)^2}{n} \right] = \frac{n}{n-1} \cdot \frac{\sum (x - \bar{x})^2}{n}$$

Regression and Correlation

Estimated product moment correlation coefficient

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \cdot \sum (y - \bar{y})^2}} = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{n} \right) \left(\sum y^2 - \frac{(\sum y)^2}{n} \right)}}$$

Estimated regression line of y on x

$$y - \bar{y} = b(x - \bar{x}), \quad \text{where } b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

Mathematical Results

AM-GM inequality

For any nonnegative real numbers x_1, x_2, \dots, x_n ,

$$\frac{x_1 + x_2 + \dots + x_n}{n} \geq \sqrt[n]{x_1 x_2 \dots x_n}$$

where equality holds if and only if $x_1 = x_2 = \dots = x_n$.

Cauchy-Schwarz inequality

For any real numbers u_1, u_2, \dots, u_n and v_1, v_2, \dots, v_n ,

$$\left(\sum_{i=1}^n u_i v_i \right)^2 \leq \left(\sum_{i=1}^n u_i^2 \right) \left(\sum_{i=1}^n v_i^2 \right)$$

where equality holds if and only if there exists a nonzero constant k such that $u_i = kv_i$ for all $i = 1, 2, \dots, n$.

Triangle inequality

For any real numbers x_1, x_2, \dots, x_n ,

$$|x_1 + x_2 + \dots + x_n| \leq |x_1| + |x_2| + \dots + |x_n|$$

where equality holds if x_1, x_2, \dots, x_n are all nonnegative.

Inclusion-Exclusion Principle

For any subsets A_1, A_2, \dots, A_n of a set,

$$\begin{aligned} |A_1 \cup A_2 \cup \dots \cup A_n| &= |A_1| + |A_2| + \dots + |A_n| \\ &\quad - [|A_1 \cap A_2| + |A_1 \cap A_3| + \dots + |A_{n-1} \cap A_n|] \\ &\quad + [|A_1 \cap A_2 \cap A_3| + \dots + |A_{n-2} \cap A_{n-1} \cap A_n|] \\ &\quad \vdots \\ &\quad + (-1)^{n-1} |A_1 \cap A_2 \cap \dots \cap A_n| \end{aligned}$$



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