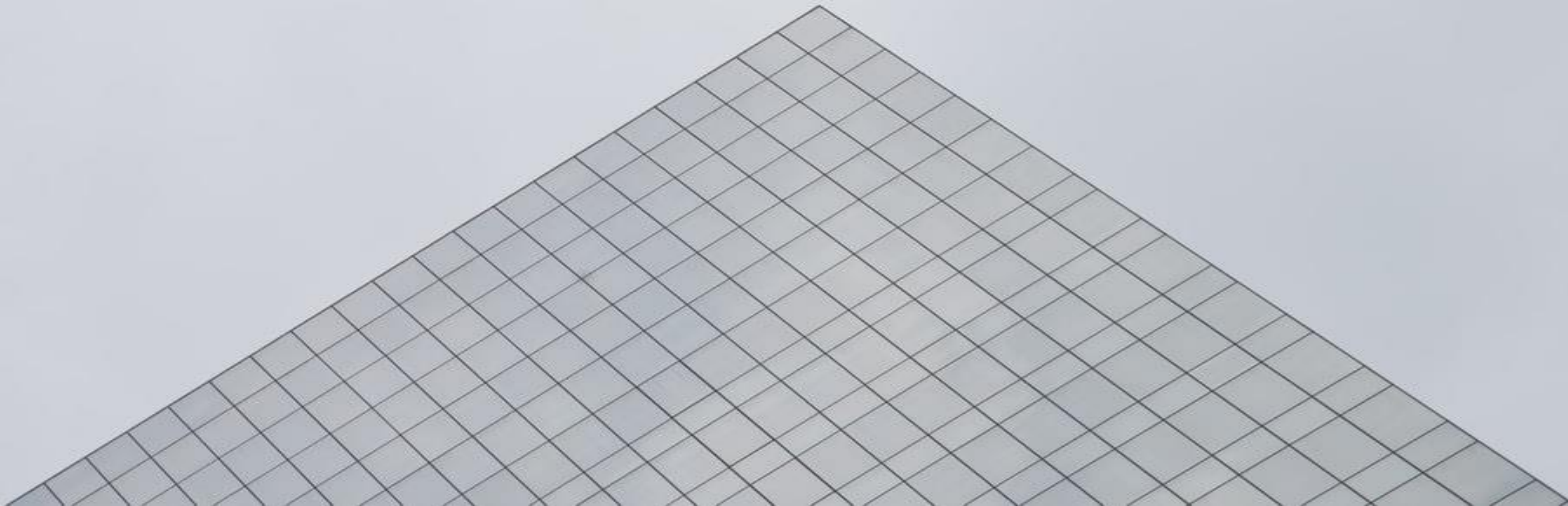
A LEVEL
H2 MATHEMATICS
MACLAURIN'S SERIES



CHAPTER ANALYSIS

MASTERY

- Maclaurin's Theorem
- Binomial Series
- Applications of Power Series of a Function

EXAM

- Differentiation techniques and partial fractions pre-requisite for this chapter
- Need to know how to expand series but don't know to memorise, given in MF26
- Angle approximation is the other common question type

WEIGHTAGE

- Low weightage, about 4%
- 1 question appears every year

Main Formulas From MF26

Binomial expansion:

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

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

Maclaurin expansion:

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

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

$$\mathrm{e}^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots + \frac{x^r}{r!} + \ldots \qquad (\text{all } x)$$

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

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

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

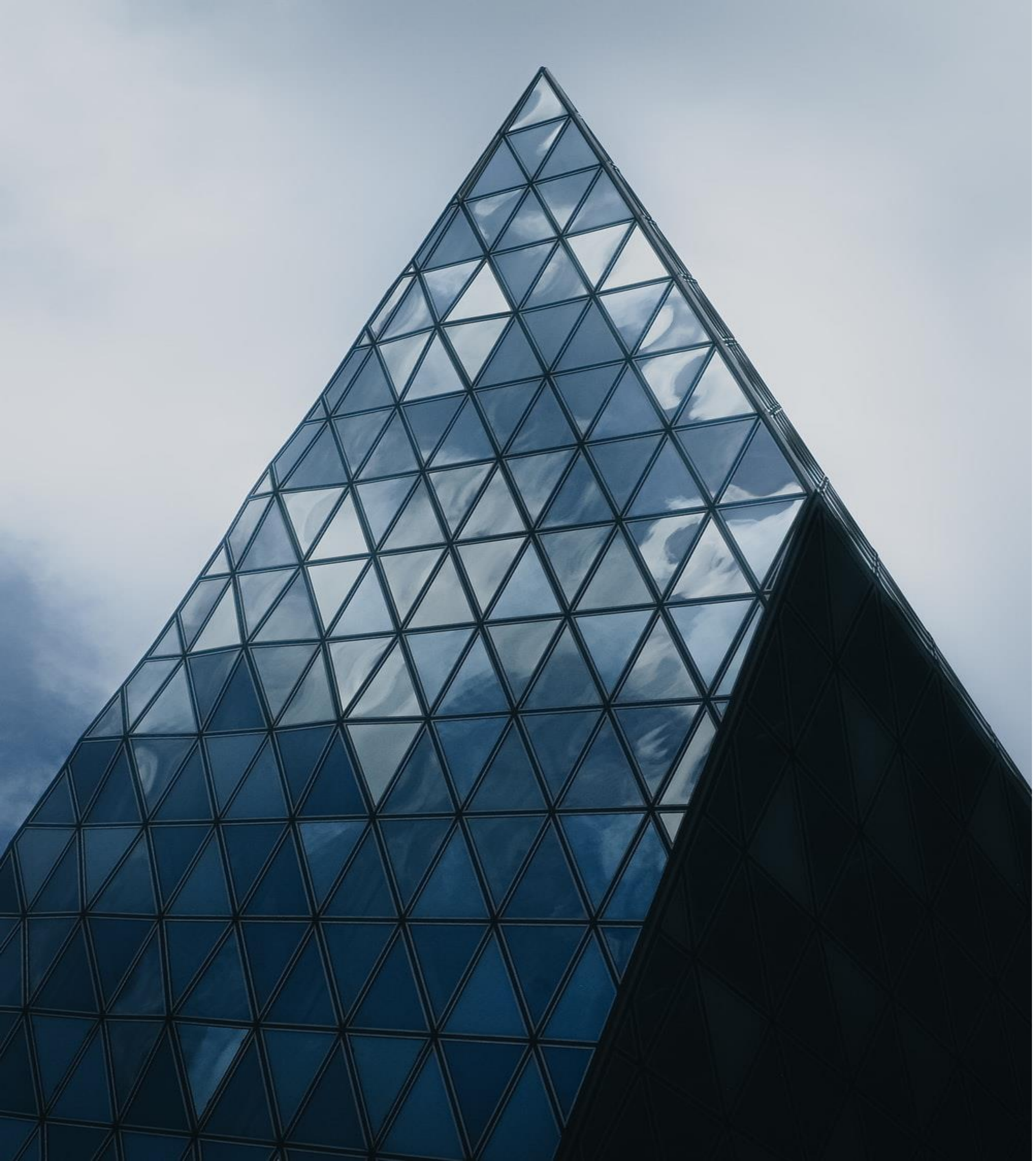
Expanding the following term up to and including the term in x^3:

$$(3+x)^{-2}$$
$$= \left[3\left(1 + \frac{x}{3}\right)\right]^{-2}$$

Must be 1

$$= \frac{1}{9}\left(1 + \frac{x}{3}\right)^{-2}$$
$$= \frac{1}{9}\left[1 - 2\left(\frac{x}{3}\right) + \frac{(-2)(-3)}{2!}\left(\frac{x}{3}\right)^2 + \frac{(-2)(-3)(-4)}{3!}\left(\frac{x}{3}\right)^3 + \cdots\right.$$
$$= \frac{1}{9} - \frac{2}{27}x + \frac{1}{27}x^2 - \frac{4}{243}x^3 + \cdots$$

Range of validity for $\left|\frac{x}{3}\right| < 1 \Rightarrow |x| < 3 \Rightarrow -3 < x < 3$



Small Angle Approximations

For sufficiently small values of θ , where θ is in radians

$$(1)\quad \sin\theta \approx \theta$$
$$(2)\quad \cos\theta \approx 1 - \frac{1}{2}\theta^2$$
$$(3)\quad \tan\theta \approx \theta$$

Given θ is sufficiently small for θ^4 and higher powers to be neglected, obtain series expansion of $\frac{\sin 2\theta}{1+\cos 3\theta}$

$$\frac{\sin 2\theta}{1+\ \cos 2\theta} \approx \frac{2\theta}{1+\left(1-\frac{(2\theta)^2}{2}\right)}$$

$$= \frac{2\theta}{2-2\theta^2}$$

$$= \theta\,(1-\theta^2)^{-1}$$

$$= \theta(1+\theta^2+\cdots)$$

$$= \theta+\theta^3$$

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Need help?

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