

Basic Math for Physics

Mar/22/2025

Mục lục

1	Quadratic Equation - Phương trình bậc 2	2
2	Common Formulae of Algebra - Hằng đẳng thức đáng nhớ	2
3	Arithmetic Progression - Tiến trình số học	2
4	Geometric Progression - Tiến trình hình học	2
5	Trigonometry Angle	3
6	Trigonometry Ratio	3
7	Trigonometry values of Larger Angles	3
8	Trigonometrical Identities	3
9	Trigonometry Formulae	4
10	Logarithm	4
11	Important formulae of logarithm	4
12	Differential Calculus	4
13	Integral Calculus	6
14	Circumferences	6
15	Formulae for Area and Volume	6

1 Quadratic Equation - Phương trình bậc 2

Với phương trình $ax^2 + bx + c = 0$ ($a \neq 0$).

Ta có $\Delta = b^2 - 4ac$.

TH1. $\Delta < 0$ phương trình vô nghiệm

TH2. $\Delta = 0$ phương trình có nghiệm kép $x_1 = x_2 = -\frac{b}{2a}$

TH3. $\Delta > 0$ phương trình có hai nghiệm phân biệt $x_{1;2} = \frac{-b \pm \sqrt{\Delta}}{2a}$

2 Common Formulae of Algebra - Hằng đẳng thức đáng nhớ

- (i) $(a + b)^2 = a^2 + b^2 + 2ab$
- (ii) $(a - b)^2 = a^2 + b^2 - 2ab$
- (iii) $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
- (iv) $(a + b)(a - b) = a^2 - b^2$
- (v) $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$
- (vi) $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$
- (vii) $(a + b)^2 - (a - b)^2 = 4ab$
- (viii) $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$
- (ix) $a^3 - b^3 = (a - b)(a^2 + b^2 + ab)$
- (x) $a^3 + b^3 = (a + b)(a^2 + b^2 - ab)$

3 Arithmetic Progression - Tiến trình số học

- (i) n^{th} term of arithmetic progression

$$a_n = a_0 + (n - 1)d$$

a_0 = First term,

n = Number of terms,

d = Common difference

= $(a_1 - a_0)$ or $(a_2 - a_1)$ or $(a_3 - a_2)$

- (ii) Sum of arithmetic progression

$$S_n = \frac{n}{2}[2a_0 + (n - 1)d] = \frac{n}{2}[a_0 + a_n]$$

a_n = last term

4 Geometric Progression - Tiến trình hình học

Here a = first term, r = common ratio (tỷ lệ chung)

- (i) Sum of ' n ' terms of G.P

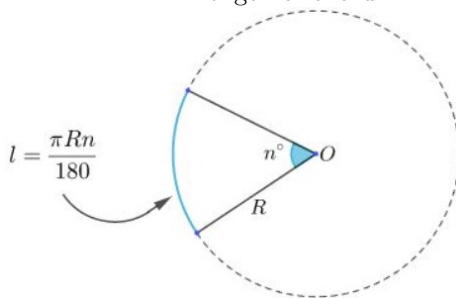
$$S_n = \frac{a(1 - r^n)}{1 - r} \quad \text{if } r < 1$$
$$S_n = \frac{a(r^n - 1)}{r - 1} \quad \text{if } r > 1$$

- (ii) Sum of infinite terms of G.P

$$S_\infty = \frac{a}{1 - r} \quad \text{if } r < 1$$
$$S_\infty = \frac{a}{r - 1} \quad \text{if } r > 1$$

5 Trigonometry Angle

Hình 1: Length of chord



$$Angle(\theta) = \frac{ArcLength}{Radius} = \frac{L}{r}$$

(formula true for radian only)

6 Trigonometry Ratio

$$\sin(\theta) = \frac{Perpendicular}{Hypotenuse} = \frac{p}{h} = \text{đi học}$$

$$\cos(\theta) = \frac{Base}{Hypotenuse} = \frac{b}{h} = \text{không hư}$$

$$\tan(\theta) = \frac{\sin(\theta)}{\cos(\theta)} = \frac{Perpendicular}{Base} = \frac{p}{b} = \text{đoàn kết}$$

$$\csc(\theta) = \frac{1}{\sin(\theta)}; \quad \sec(\theta) = \frac{1}{\cos(\theta)}; \quad \cot(\theta) = \frac{1}{\tan(\theta)}$$

7 Trigonometry values of Larger Angles

$$\begin{aligned} \sin(180^\circ - \theta) &= \sin(\theta) & \sin(360^\circ - \theta) &= -\sin(\theta) \\ \cos(180^\circ - \theta) &= -\cos(\theta) & \cos(360^\circ - \theta) &= \cos(\theta) \\ \tan(180^\circ - \theta) &= -\tan(\theta) & \tan(360^\circ - \theta) &= -\tan(\theta) \\ \sin(180^\circ + \theta) &= -\sin(\theta) & \sin(360^\circ + \theta) &= \sin(\theta) \\ \cos(180^\circ + \theta) &= -\cos(\theta) & \cos(360^\circ + \theta) &= \cos(\theta) \\ \tan(180^\circ + \theta) &= \tan(\theta) & \tan(360^\circ + \theta) &= \tan(\theta) \end{aligned}$$

8 Trigonometrical Identities

(i) $\sin^2(\theta) + \cos^2(\theta) = 1$

(ii) $\sec^2(\theta) - \tan^2(\theta) = 1$

(iii) $\csc^2(\theta) + \cot^2(\theta) = 1$

9 Trigonometry Formulae

$$\sin(A + B) = \sin(A)\cos(B) + \cos(A)\sin(B)$$

$$\sin(A - B) = \sin(A)\cos(B) - \cos(A)\sin(B)$$

$$\cos(A + B) = \cos(A)\cos(B) - \sin(A)\sin(B)$$

$$\cos(A - B) = \cos(A)\cos(B) + \sin(A)\sin(B)$$

$$\tan(A + B) = \frac{\tan(A) + \tan(B)}{1 - \tan(A)\tan(B)}$$

$$\tan(A - B) = \frac{\tan(A) - \tan(B)}{1 + \tan(A)\tan(B)}$$

$$\sin(2\theta) = 2\sin(\theta)\cos(\theta)$$

$$\cos(2\theta) = \cos^2(\theta) - \sin^2(\theta) = 2\cos^2(\theta) - 1 = 1 - 2\sin^2(\theta)$$

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

10 Logarithm

If $a^x = N$ then $\log_a(N) = x$

Conversion of natural log into common log:

$$\log_e(x) = \ln(x) = 2.3026\log_{10}(x)$$

11 Important formulae of logarithm

(i) $\log_a(m.n) = \log_a(m) + \log_a(n)$

(ii) $\log_a(m/n) = \log_a(m) - \log_a(n)$

(iii) $\log_a(m^n) = n\log_a(m)$

12 Differential Calculus

$y = x^n$	$\frac{dy}{dx} = nx^{n-1}$	$y = \sin(x)$	$\frac{dy}{dx} = \cos(x)$
$y = kx$	$\frac{dy}{dx} = k\frac{dx}{dx} = k$	$y = \cos(x)$	$\frac{dy}{dx} = -\sin(x)$
$y = k$	$\frac{dy}{dx} = 0$	$y = \tan(x)$	$\frac{dy}{dx} = \sec^2(x)$
$y = \frac{1}{x}$	$\frac{dy}{dx} = -\frac{1}{x^2}$	$y = \csc(x)$	$\frac{dy}{dx} = -\cot(x)\operatorname{cosec}(x)$
$y = \sqrt{x}$	$\frac{dy}{dx} = \frac{1}{2\sqrt{x}}$	$y = \sec(x)$	$\frac{dy}{dx} = \sec(x)\tan(x)$
$y = \ln(x)$	$\frac{dy}{dx} = \frac{1}{x}$	$y = \cot(x)$	$\frac{dy}{dx} = -\operatorname{cosec}^2(x)$
$y = \log_a(x)$	$\frac{dy}{dx} = \frac{1}{x}\log_a(e)$		
$y = e^x$	$\frac{dy}{dx} = e^x$		
$y = a^x$	$\frac{dy}{dx} = a^x\log_e(a)$		

$(u + v)' = u' + v'$	$(u - v)' = u' - v'$	$(u.v)' = u'v + v'u$	$(\frac{u}{v})' = \frac{u'.v - v'.u}{v^2}$
$(e^u)' = u'.e^u$	$\ln(u)' = \frac{u'}{u}$	$(u^\alpha)' = \alpha.u^{\alpha-1}.u'$	$(\sqrt{u})' = \frac{u'}{2\sqrt{u}}$
$(\sqrt[n]{u})' = \frac{u'}{n\sqrt[n]{u^{n-1}}}$	$(\sin(u))' = u' \cdot \cos(u)$	$(\cos(u))' = -u' \cdot \sin(u)$	$(a^u)' = u'.a^u \cdot \ln(a)$
$(\log_a(u))' = \frac{u'}{u \cdot \ln(a)}$			

$$(\tan(u))' = \frac{u'}{\cos^2(u)}$$

$$(\cot(u))' = -\frac{u'}{\sin^2(u)}$$

$$\left[(x^m)^n \right]' = (m \geq n) \quad ? \quad m(m-1)(m-2)\dots(m-n+1)x^{m-n} : 0$$

$$(\log_a(x))^n = (-1)^{n-1} \cdot \frac{(n-1)!}{\ln(a)} \cdot \frac{1}{x^n}$$

$$(\ln(x))^n = (-1)^{n-1} \cdot (n-1)! \cdot x^{-n}$$

$$(e^{kx})^n = k^n \cdot e^{kx}$$

$$(a^x)^n = (\ln(a))^n \cdot a^x$$

$$(\sin(ax))^n = a^n \cdot \sin(ax + n \cdot \pi/2)$$

$$(\cos(ax))^n = a^n \cdot \cos(ax + n \cdot \pi/2)$$

$$\left(\frac{1}{ax+b} \right)^n = (-1)^n \cdot a^n \cdot n! \cdot \frac{1}{(ax+b)^{n+1}}$$

$$(\arcsin(x))' = \frac{1}{\sqrt{1-x^2}}$$

$$(\arccos(x))' = \frac{-1}{\sqrt{1-x^2}}$$

$$(\arctan(x))' = \frac{1}{1+x^2}$$

Chain rule

$$\left[f(g(x)) \right]' = f'(g(x)) \cdot g'(x)$$

13 Integral Calculus

$y = x^n$	$\int x^n dx = \frac{x^{n+1}}{n+1} + c$	$y = \sin(x)$	$\int \sin(x) dx = -\cos(x)$
$y = k$	$\int k dx = kx + c$	$y = \cos(x)$	$\int \cos(x) dx = \sin(x)$
$y = 1$	$\int dx = x + c$	$y = \sec^2(x)$	$\int \sec^2(x) dx = \tan(x)$
$y = \frac{1}{x}$	$\int \frac{1}{x} dx = \ln(x) + c$	$y = \sec(x)\tan(x)$	$\int \sec(x)\tan(x) dx = \sec(x)$
$y = e^x$	$\int e^x dx = e^x + c$	$y = \operatorname{cosec}^2(x)$	$\int \operatorname{cosec}^2(x) dx = -\cot(x)$
$y = a^x$	$\int a^x dx = \frac{a^x}{\log_e(a)} + c$	$y = \operatorname{cosec}(x)\cot(x)$	$\int \operatorname{cosec}(x)\cot(x) dx = -\operatorname{cosec}(x)$

14 Circumferences

1. Circumference of circle: $C = 2\pi R$
2. Circumference of triangle: $P = a + b + c$

15 Formulae for Area and Volume

1. Area of square = $(side)^2$
2. Area of rectangle = $length \times length$
3. Area of triangle = $\frac{1}{2} \times base \times height$
4. Area of equilateral triangle = $\frac{\sqrt{3}}{4}a^2$
5. Area enclosed by a circle = πr^2
6. Surface area of sphere = $4\pi r^2$
7. Surface area of cube = $6L^2$
8. Surface area of cuboid
= $2[L \times b + b \times h + h \times L]$
9. Area of curved surface of cylinder = $2\pi rl$
10. Volume of cube = L^3
11. Volume of cuboid = $L \times b \times h$
12. Volume of sphere = $\frac{4}{3}\pi r^3$
13. Volume of cylinder = $\pi r^2 l$
14. Volume of cone = $\frac{1}{2}\pi r^2 h$