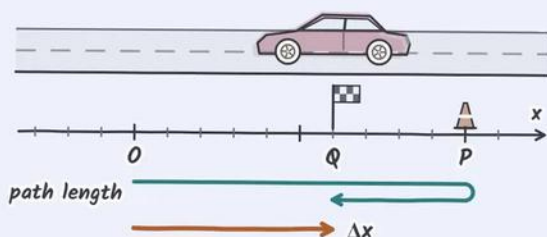


motion described with calculus, and vectors put on a plane

Position, and the words that are not interchangeable

- motion is always relative to a frame of reference, so rest and motion are statements about a frame and never about a body alone
- distance is the path length and is never negative; displacement is the straight line from start to finish and carries a direction
- speed is distance over time and velocity is displacement over time, so a body can move at steady speed with changing velocity
- average velocity uses the whole interval, instantaneous velocity is the limit as that interval shrinks to zero, which is where calculus enters



there and back: the distance counts every metre of the path, the displacement only start to finish

ISC teaches this, the NCERT course does not

The calculus this course actually needs

- differentiation is a rate of change: velocity is the rate of change of position and acceleration the rate of change of velocity, so $v = dx/dt$ and $a = dv/dt$
- the chain of it: $a = dv/dt = d^2x/dt^2$, and $a = v dv/dx$ when acceleration is wanted in terms of position rather than time
- integration is the reverse: displacement is the integral of velocity over time, and velocity the integral of acceleration
- the syllabus names the derivatives to know: x^n , $\sin x$, $\cos x$, e^x and $\ln x$, and the integral of $x^n dx$. Both definite and indefinite integrals are mentioned, and elementary calculus is not evaluated beyond this

The five derivatives and the one integral named

Function	Derivative	Function	Derivative
x^n	$n x^{n-1}$	e^x	e^x
$\sin x$	$\cos x$	$\ln x$	$1/x$
$\cos x$	$-\sin x$	constant	0
integral of $x^n dx$	$x^{n+1} / (n+1) + c$, for n not equal to -1		

these are the only ones the paper assumes, and every kinematic result below is reachable with them