

2.4.8 Graph Rates

Name: _____ Class: _____ Date: _____

KEY WORDS tangent gradient

<!-- Session 2 native-skill companion -->

Objective

Practise graph rates within the labelled native lessons. Public original tasks; locally authored answer guidance.

1 Key knowledge and worked examples

■ Graphical gradients and area estimates · Higher

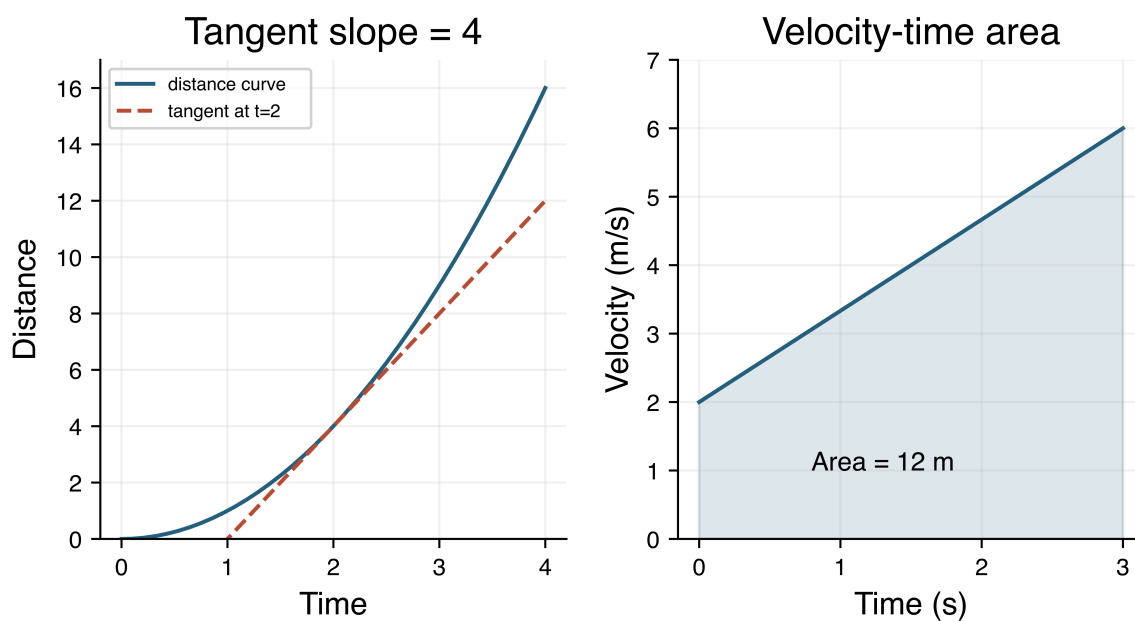
A chord gives an average rate between two inputs; a tangent estimates the local rate. Read two well-separated points on the drawn tangent to reduce measurement error. On a velocity-time graph, area represents displacement. Split it into triangles/trapezia or estimate curved area using narrow strips.

$$\frac{9-1}{3-1} = 4, \quad A = \frac{2+6}{2} \times 3 = 12$$

For a distance curve $d=t^2$, the chord from (1,1) to (3,9) has gradient $(9-1)/(3-1)=4$. A tangent at (2,4) passes through (1,0) and (3,8), giving gradient 4 without calculus. A velocity-time trapezium with endpoint velocities 2 and 6 m/s over 3 s has area $(2+6) \times 3/2 = 12$ m. Smaller strips can improve a curved-area estimate; curvature affects over/underestimation. A cost-versus-quantity tangent through (2,12) and (6,28) gives a local rate $(28-12)/(6-2)=4$ yuan per extra item, linking graph slope to a financial interpretation.

Tangent estimates and curve chords use different pairs of points. Area under a distance-time graph is not distance travelled. A strip estimate is approximate unless the graph is linear on each strip.

AQA A15 and R15 Higher require graph-based rates and area interpretation. This lesson uses graphical reasoning and geometric areas, not symbolic differentiation/integration.



Original native-lesson illustration; labels belong to its worked example.

2 Practice

2.1 (Higher) Find the chord gradient from (1,1) to (3,9).

2.2 (Higher) Find the tangent gradient from (1,0) to (3,8).

2.3 (Higher) Find the velocity trapezium displacement for 2 and 6 m/s over 3 s.

3 Exam-style questions

3.1 Decide whether this claim is true. Justify with a concrete calculation or counterexample: Area under any graph always means the distance travelled.

Solutions

2.1 $(9-1)/(3-1)=4$.

2.2 $(8-0)/(3-1)=4$.

2.3 Average endpoint height 4 times width 3 gives 12.

3.1 False. Area under a speed-time graph gives distance, but a constant force 2 N over displacement 3 m gives area 6 J of work. Interpret the axis units first.

Local review guidance: show the chosen method; give the checked result; explain the condition or failed shortcut. This is authored classroom guidance.