Rectilinear motion and acceleration forms

Learn and practise | Free preview

A sample from this topic. The complete topic collection contains three different resources and worked solutions.

Read the worked example, then show each step in the practice questions. Show the mathematical steps. A calculator, graphing tool or CAS may be used to check results where useful.

What you will practise

• Kinematics: rectilinear motion

Useful starting skills: Specialist and Methods Units 1–2; concurrent or completed Mathematical Methods Units 3–4.

For position x(t), velocity is v=dx/dt and acceleration is a=dv/dt. Displacement is the signed integral of velocity; distance travelled is the integral of |v| and usually requires splitting at direction changes.

When acceleration depends on position, the chain rule gives $a=v\,dv/dx=d(v^2/2)/dx$. Speed is |v|. A particle speeds up when velocity and acceleration have the same sign and slows down when their signs differ.

Worked example

A particle has v(t)=2 t-4 m/s for 0≤t≤3. Find displacement and distance travelled.

The particle turns at t=2

signed integrals are -4 m on [0, 2] and +1 m on [2, 3]

add signed values for displacement and magnitudes for distance.

Answer: Displacement -3 m; distance 5 m.

Try it yourself

Name: _____ Date: _____

1. For $x(t)=t^3-3t^2+2$, find velocity and acceleration.

2. For $v(t)=6-2t$ m/s, find when the particle first stops and its displacement by that time.

Answers and explanations

Check the method as well as the final answer. An alternative correct method is also valid.

1. $v=3t^2-6t$; $a=6t-6$.

Differentiate position twice with respect to time.

2. $t=3$ s; displacement 9 m.

Set velocity to zero, then integrate from 0 to 3.

Curriculum reference: Specialist Mathematics Units 3–4 — Kinematics: rectilinear motion

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