Curriculum and assessment congruence - Computer Algebra Systems (CAS) in Victoria, Australia

By

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Victorian Certificate of Education (VCE) Unit 3 and 4 courses

Further Mathematics (non calculus)

- Core - data analysis
- Application modules (select 3 from 5)
  - Number patterns and applications
  - Geometry and trigonometry
  - Graphs and relations
  - Business related mathematics
  - Networks and decision mathematics

Victorian Certificate of Education (VCE) Unit 3 and 4 courses (ctd)

Mathematical Methods (calculus and probability)

This is a completely prescribed course with the areas of study:

- Coordinate geometry
- Circular (trigonometric) functions
- Calculus
- Algebra
- Statistics and probability

Victorian Certificate of Education (VCE) Unit 3 and 4 courses (ctd)

Specialist Mathematics - this is a completely prescribed course of more demanding function, calculus and algebra based mathematical content with the areas of study:

- Coordinate geometry
- Circular (trigonometric) functions
- Algebra, including complex numbers
- Calculus, including kinematics and differential equations
- Vectors including vector calculus
- Mechanics

Enrolments, Unit 4 1999

(to the nearest 1000)

English (compulsory)	46 000
Further Mathematics	17 000
Mathematical Methods	18 000
Specialist Mathematics	6 000

Specialist Mathematics requires Mathematical Methods to be studied concurrently, or have been studied previously

VCE Mathematics
Unit 3 and 4 assessment

Coursework assessment 34%

Examination 1 33%

(1.5 hour, multiple choice and short answer
- Facts, skills and applications task)

Examination 2 33%

(1.5 hour, extended response questions
- Analysis task)

Coursework assessment

Tests	1 period
Analysis tasks	3 - 5 periods
Application tasks	6 - 10 periods

Structure of coursework assessment

UNIT	FM	MM	SPM
3	Application task Analysis task	Application task Two tests	Two analysis task
4	Two analysis task	Two analysis task	Application task Two tests

Use of technology in final year secondary mathematics examinations

- Mid 1970's - scientific calculators permitted
- 1997 - 8 Graphics calculators permitted
- 1999 - Mathematical Methods and Specialist Mathematics, graphics calculator 'assumed access'
- 2000 - Graphics calculators 'assumed access' all courses

Phases in Implementation

- Graphics calculator ‘neutral’ examinations
  - no ‘undue advantage’
- Graphics calculator ‘assumed access’
  - students selects whether to use technology or not, in some cases this is likely to be a more effective approach or only possible approach
- Graphics calculator ‘active’
  - use of calculator is required to answer some questions

Use of computer algebra systems (CAS) in examinations

- not allowed
  - calculators with full symbolic capability not allowed (eg current Victorian Certificate of Education)
- allowed
  - ‘CAS neutral’ examinations (eg France)
- assumed
  - new types of questions, not be readily tackled by hand or using graphic calculator technology (eg Denmark?)

Current examination questions

- Some current questions can be done by direct CAS evaluation
- for other questions, CAS can be used to do parts of working and check results
- some questions can not be done by CAS, for example, proof type questions (although CAS could facilitate some steps of working)

Alternative examination types

- examinations separated into ‘technology free’ and ‘technology active’ components
- unrestricted use of technology in a ‘neutral’ context
- technology ‘active’ examinations, eg an electronic examination using CAS notebook environment
- ‘free’ and ‘active’ components

Types of questions can include:

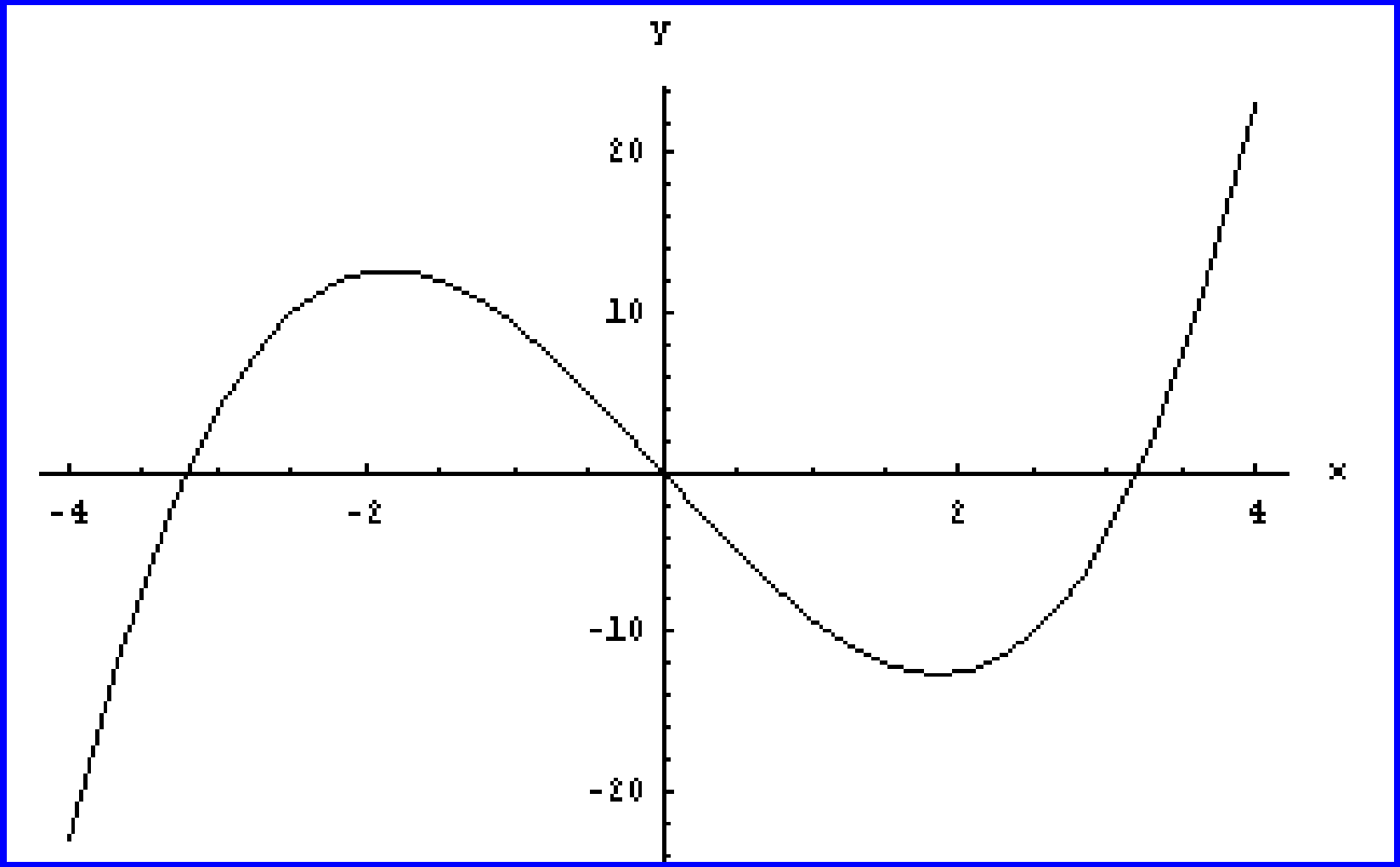
- Factual - eg knowledge of definitions
  conceptual - eg asymptotic behaviour
- formulation - eg setting up an equation
- skill application - eg differentiation
- process - eg applying Euler's method for de's
- interpretation - eg graphical information
- proof - eg deriving a result, general case

Sample task

Find the rule of a cubic function that has no stationary points and verify this. Obtain a general form for this type of cubic function.

Sample task (ctd)

Consider the following conjecture: “For any cubic function, c, with rule $y = c(x)$, there is a real number k, such that the points of intersection of $y = c(x)$ and $y = k$ are symmetrically located with respect to some point on the line $y = k$.”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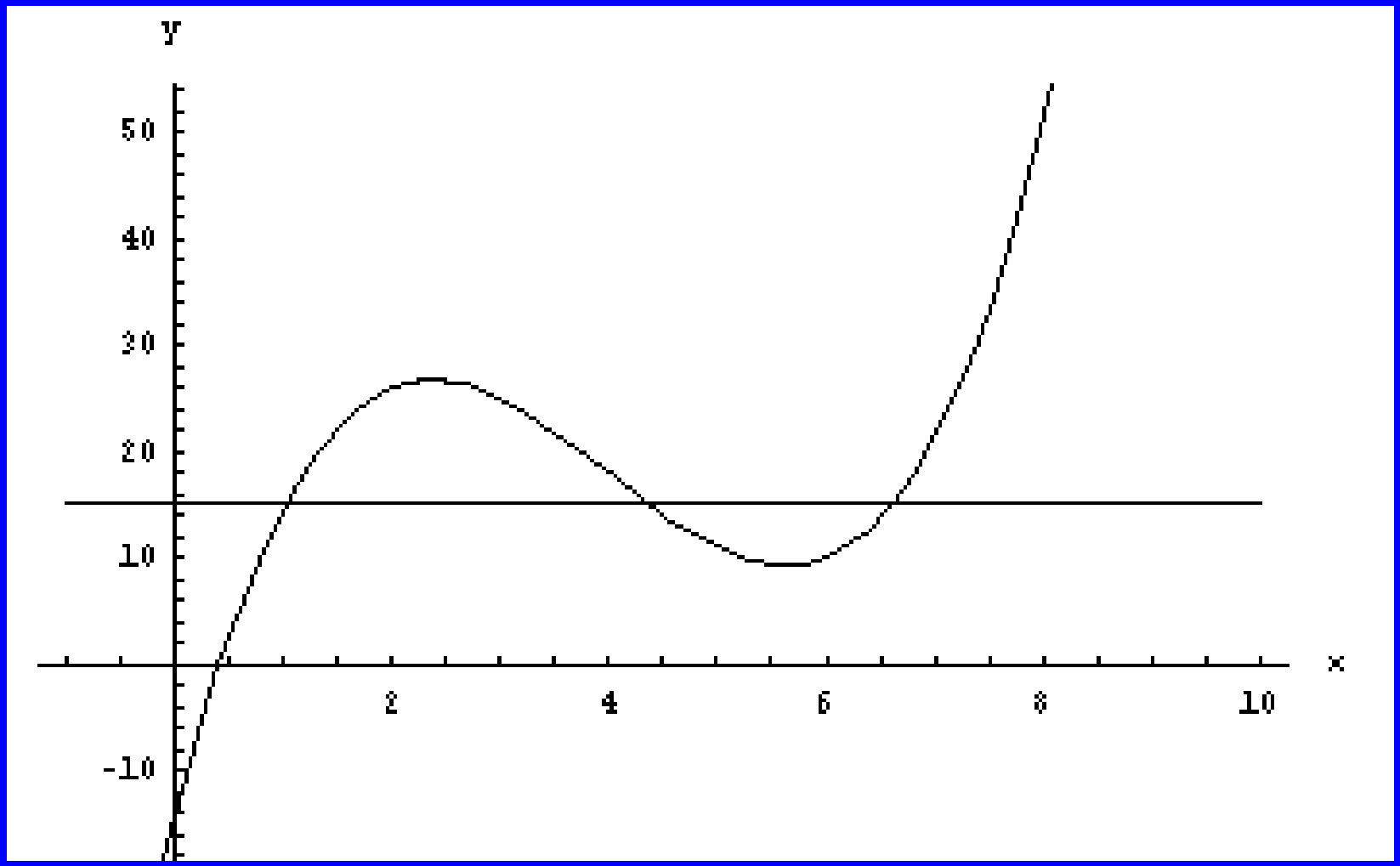
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Sample task (ctd)

Select a cubic function, with turning points, that has only one x axis intercept, and determine whether the conjecture is true for this function for some value of $k \neq 0$.

Investigate whether the conjecture is true of cubic functions more generally.