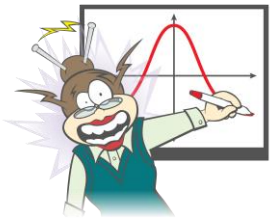
Mathematical Methods – Further Differential Calculus Question Sheet



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Each of the questions included here can be solved using the TI-Nspire CX CAS.

Question 1

Using calculus on a Calculator Page, find the coordinates of the stationary point(s) of the following:

a) $f(x) = x^3 - 5x^2 - 8$

b) $g(x) = x^3 - 5x - 8$.

Response:

Question 2

Using calculus on a Notes Page, find the coordinates of the stationary point(s) of the following:

a) $f(x) = x^4 - 5x^2$

Note: To do part a), add Math Boxes(ctrl+M) on the Notes Page and enter appropriate formulae.

b) $f(x) = x^4 - 6x^2 + 8$

Note: To do part b), edit the Math Box on the Notes Page with the equation formula from part a) and press enter.

Response:

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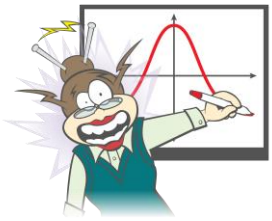


Question 3

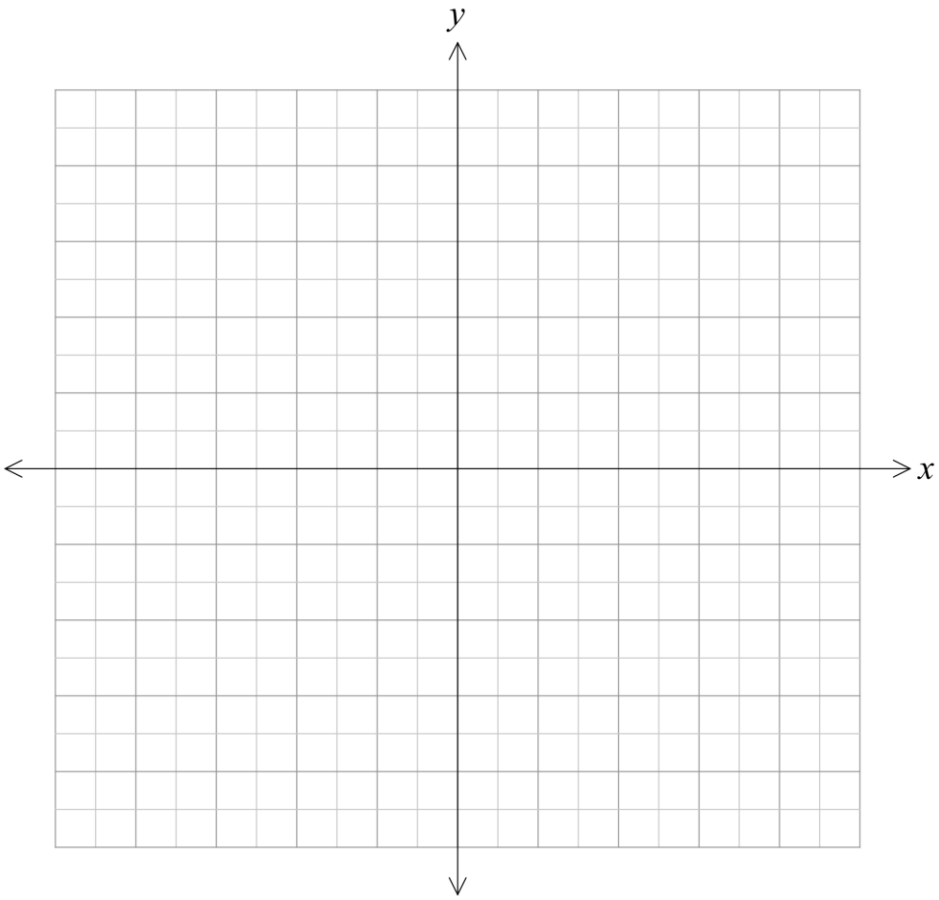
a) Find the axial intercepts of $f(x) = x^4 - 6x^2 + 8$.

Note: To do part a), add Math Boxes(ctrl+M) to the Notes Page created in Question 2.
Consider tidying up the Notes Page with some text explanation and formatting.

b) Sketch the graph of $y = f(x)$, labelling the coordinates of all stationary points and axial intercepts.

Note: To do part b), add a Graphs Page to your CAS document and type $f1(x) = f(x)$ in the Graph Entry Line(ctrl+G). Copy the graph to the axes below and label coordinates of the relevant points found in the Notes Page. Watch the webinar to see how to turn what you have just created into a widget.

Response:



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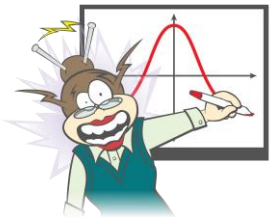
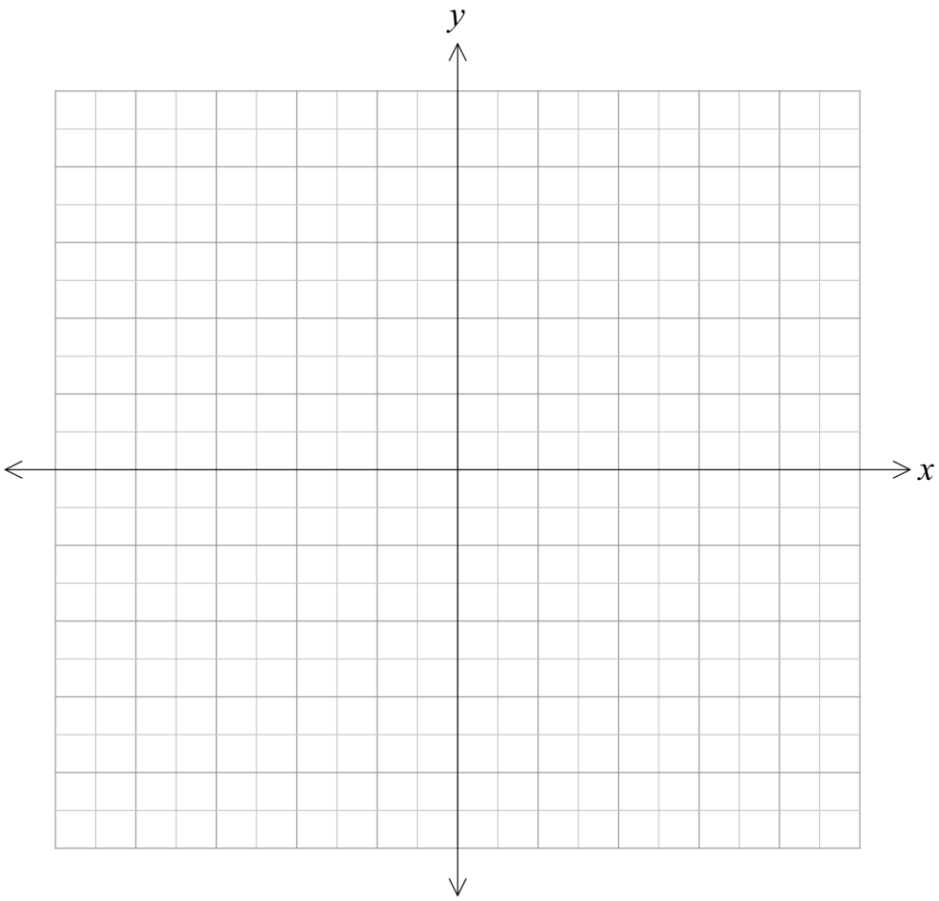


Question 4

Sketch the graph of $y = x + 1 + \sin(2x)$, $-\pi < x \leq \frac{\pi}{2}$, labelling the coordinates of all stationary points, axial intercepts and endpoints correct to 2 decimal places.

Note: This question should be attempted again with the widget made in the webinar. The result will be interesting, so watch this section of the webinar again.

Response:



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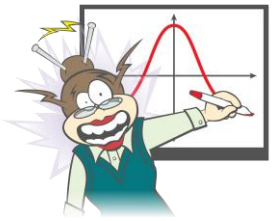

Question 5

If $f(x) = x^2 \cdot \sqrt{2x-3}$, show that $f'(x) = 2x \cdot \sqrt{2x-3} + \frac{x^2}{\sqrt{2x-3}}$.

Response:

Question 6

If $f(x) = \frac{x^2}{e^{2x}}$, show that $f'(x) = \frac{2x(1-x)}{e^{2x}}$.

Response:

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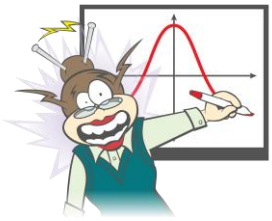

Question 7

If $y = \sin\left(2x^2\right)$, show that $\frac{dy}{dx} = 4x \cdot \cos\left(2x^2\right)$.

Response:

Question 8

Consider the function $f\left(x\right) = -\left(x+2\right)^2\left(x-4\right)$. State the domain over which the function $y = f\left(x\right)$ is strictly increasing.

Response:

Question 9

A particle moves in a straight line so that its position, x metres, from a fixed origin, O, at a time, t seconds, is given by

$$x\left(t\right) = t^3 - 6t^2 + 9t, t \geq 0.$$

a) How far is the particle from O after 4 seconds?

b) What is the velocity of the particle at any time t ?

c) When is the acceleration of the particle 5 ms^{-2} ?

Response:

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