Marked example 1

Paper 1 style · No calculator

1 7 marks SL 5.11 ●●○ Typical

Let $f(x) = x^3 - 4x$.

(a) Find the x-intercepts of the graph of f. **[2]**

(b) Find the total area of the regions enclosed by the graph of f and the x-axis. **[4]**

(c) Explain why $\int_{-2}^{2} f(x)\,\mathrm{d}x = 0$. **[1]**

MARKSCHEME (a)

$x(x-2)(x+2) = 0$ **(M1)**

$x = -2,\ x = 0,\ x = 2$ **A1**

Total 2 marks

MARKSCHEME (b)

$\int_{-2}^{0} f(x)\,\mathrm{d}x = \left[\frac{x^4}{4} - 2x^2\right]_{-2}^{0} = 0 - (4-8) = 4$ **A1**

$\int_{0}^{2} f(x)\,\mathrm{d}x = (4-8) - 0 = -4$ **A1**

$\text{area} = 4 + |-4|$ **M1**

$= 8$ **A1**

Total 4 marks

MARKSCHEME (c)

the region below the axis cancels the region above (they have equal areas) **R1**

Total 1 mark

Written and verified by a practising IB mathematics teacher, produced with AI assistance; solved twice and recomputed by software.
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