

1 Prove, from first principles, that the derivative of  $5x^2$  is  $10x$ . (4 marks)

2  $f(x) = x^3 + 4x^2 + 35x + 20$   
Find the set of values of  $x$  for which  $f(x)$  is increasing. (5 marks)

3 A curve  $C$  has equation  $y = x^3 + x^2 + x + 2$   
The point  $P$  has  $x$ -coordinate 2

a Find  $\frac{dy}{dx}$  in terms of  $x$ . (2 marks)

b Find the equation of the tangent to the curve  $C$  at the point  $P$ . (4 marks)

The normal to  $C$  at  $P$  intersects the  $x$ -axis at  $A$ .

c Find the coordinates of  $A$ . (4 marks)

4  $f(x) = x^3 + 7x^2 + 24x + 18$   
Sketch the graph of the gradient function,  $y = f'(x)$ . Use algebraic methods to determine any points where the graph cuts the coordinate axes and mark these on the graph. Using calculus, find the coordinates of any turning points on the graph. (9 marks)

5 A fish tank in the shape of a cuboid is to be made from 1600  $\text{cm}^2$  of glass.  
The fish tank will have a square base of side length  $x$  cm, and no lid. No glass is wasted.  
The glass can be assumed to be very thin.

a Show that the volume,  $V \text{ cm}^3$ , of the fish tank is given by  $V = 400x - \frac{x^3}{4}$ . (5 marks)

b Given that  $x$  can vary, use differentiation to find the maximum or minimum value of  $V$ . (4 marks)

c Justify that the value of  $V$  you found in part b is a maximum. (2 marks)

# Pure Mathematics 1 Differentiation Unit 1

**Joseph Blakey**



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**Bibliography** Arthur James Wells, 1979 **Bulletin** University of California (System). University Extension, 1917

*Heinemann Modular Maths Edexcel Further Pure Maths 3* Geoff Mannall, Michael Kenwood, 2004-10 Drawing on over 10 years experience of publishing for Edexcel maths Heinemann Modular Maths for Edexcel AS and A Level brings you dedicated textbooks to help you give your students a clear route to success now with new Core maths titles to match the new 2004 specification Further Pure 3 replaces Pure 6 in the new specification Which Degree?, 1981 **The Quarterly**

**Journal of Pure and Applied Mathematics** James Joseph Sylvester, James Whitbread Lee Glaisher, 1927 *Which University?*, 1975 American Journal of Mathematics Pure and Applied, 1926 V. Mathematics and the age of the earth. VI. Pure diffusion of electric displacement. Appendix C: Rational units. VII. Electromagnetic waves and generalised differentiation. VIII. Generalised differentiation and divergent series. Appendices: D. On compressional electric or magnetic waves. E. Dispersion. F. On the transformation of optical wave surfaces by homogeneous strain. G. Note of the motion of a charged body at a speed equal to or greater than that of light. H. Note on electrical waves in sea water. I. Note on the attenuation of Hertzian waves along wires.-v. 3. IX. Waves from moving sources. Appendix J: Note on the size and inertia of electrons. Appendix K. Vector analysis. X. Waves in the ether Oliver Heaviside, 1925 **AS Level Mathematics Through**

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