# Re: Reference for a cubic with a double root?

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In article <cfcf5h$9em$1@panix1.panix.com>,
baloglou@panix.com (George Baloglou) wrote:

*>*
*> .... I still need a reference where the condition*
*> is literally spelled out, *not for the special case b = 0*, but for the*
*> general case, *preferably even when a is not taken to be equal to 1* :−)*
*> [I see that this is done in (my Aristotle University professor) Konstantinos*
*> Lakkis's "Algebra" (1976), but that book is written in Greek, and I need a*
*> reference in English; C. C. MacDuffee's "Theory of Equations" (1954) comes*
*> close to what I need in Theorem 50* (p. 91), except that he assumes a = 1*
*> (a very minor offense which I would still prefer to avoid if possible).]*
*>*
*> *With D = (b^2)(c^2) − 4(c^3) − 4(b^3)d − 27(d^2) + 18bcd, the cubic*
*> x^3 + bx^2 + cx + d has a double (real) root in case D = 0, three distinct*
*> real roots in case D > 0, and precisely one real root in case D < 0 ....*

For such traditional algebra I usually look at S. Barnard & J. M. Child, "Higher Algebra," Macmillan, 1936 and reprints. Their Chapter XII begins (on pp.179−180) with the general cubic

a(x^3) + 3b(x^2) + 3cx + d = 0

and moves on quickly to the discriminant and its properties. This seems exactly what you want, except for the two coefficients where they introduce factors of 3 to simplify various formulae.

Ken Pledger.