1. (a) Sketch, on the same axes, in the interval $0 \leq x \leq 180$, the graphs of

$$y = \tan x° \text{ and } y = 2 \cos x°,$$

showing clearly the coordinates of the points at which the graphs meet the axes.

(4)

(b) Show that $\tan x° = 2 \cos x°$ can be written as

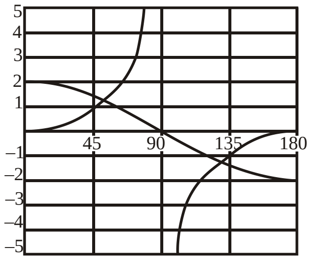
$$2 \sin^2 x° + \sin x° - 2 = 0.$$

(3)

(c) Hence find the values of x, in the interval $0 \leq x \leq 180$, for which $\tan x° = 2 \cos x°$.

(4)
(Total 11 marks)

1. (a)



	Tangent graph shape	M1	
	180 indicated	A1	
	Cosine graph shape	M1	
	2 and 90 indicated	A1	4
	Allow separate sketches.		
(b)	Using $\tan x = \dfrac{\sin x}{\cos x}$ and multiplying both sides by $\cos x$. ($\sin x = 2\cos^2 x$)	M1	
	Using $\sin^2 x + \cos^2 x = 1$	M1	
	$2\sin^2 x + \sin x - 2 = 0$ (*)	A1	3
(c)	Solving quadratic: $\sin x = \dfrac{-1 \pm \sqrt{17}}{4}$ (or equiv.)	M1 A1	
	$x = 51.3$ (3 s.f. or better, 51.33…) α	A1	
	$x = 128.7$ (accept 129) (3 s.f. or better) $180 - \alpha$ ($\alpha \neq 90n$)	B1ft	4

[11]

1. Graph sketches in part (a) were often disappointing, with the tangent graph in particular proving difficult for many candidates. While some indicated the asymptote clearly, others seemed unsure of the increasing nature of the function or of the existence of a separate branch. Sketches of $y = 2\cos x$ were generally better, although some confused this with $y = \cos 2x$.

Part (b) was usually well done, with most candidates being aware of the required identities $\tan x = \dfrac{\sin x}{\cos x}$ and $\sin^2 x + \cos^2 x = 1$.

Although in part (c) some candidates produced a factorisation of the quadratic function, the majority used the quadratic formula correctly to solve the equation.

A few the omitted the second solution, but apart from this the main mistake was to approximate prematurely and then to give the answer to an inappropriate degree of accuracy (e.g. sin x = 0.78, therefore x = 51.26).