Cambridge International Examinations
Cambridge Pre-U Certificate

MATHEMATICS (PRINCIPAL) **9794/02**

Paper 2 Pure Mathematics 2 **For Examination from 2016**

SPECIMEN MARK SCHEME

2 hours

MAXIMUM MARK: 80

The syllabus is approved in England, Wales and Northern Ireland as a Level 3 Pre-U Certificate.

This document consists of **6** printed pages.

Mark Scheme Notes

Marks are of the following three types:

M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

B Mark for a correct result or statement independent of method marks.

The following abbreviations may be used in a mark scheme:

AG Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)
aef Any equivalent form
art Answers rounding to
cwo Correct working only (emphasising that there must be no incorrect working in the solution)
ft Follow through from previous error is allowed
o.e. Or equivalent

1	**(a) (i)**	$\log_a 15$	B1
	(ii)	Use $b \log a = \log a^b$ at least once	M1
		Use $\log a - \log b = \log \frac{a}{b}$	M1
		Obtain $\log_b \frac{1}{2}$	A1
	(b)	$\frac{1}{3}$	B1
		$\frac{1}{3a^2}$ o.e.	B1
	(c)	Attempt to multiply numerator and denominator by $2\sqrt{3}+3$	M1
		Obtain $\frac{18+7\sqrt{3}-3}{12-9}$	A1
		Obtain given answer	A1
2		$\frac{1}{2}x(x+2)\sin 30^\circ = 12$ or simplified expression	B1
		Rearrange to get a quadratic equation including putting $\sin 30^\circ = \frac{1}{2}$	M1
		Obtain $x^2 + 2x - 48 = 0$	A1
		Solve *their* quadratic equation	M1
		Obtain $x = 6$ only	A1
3	**(i)**	Attempt to find gradient	M1
		Get gradient $-\frac{1}{4}$	A1
		Find c to be 3 ($y = -\frac{1}{4}x + 3$)	A1
	(ii)	$-\frac{1}{4} \times -4 = 1$	B1
		No, gradients multiplied together $\neq -1$	B1

4	**(i)**	Compare coefficients	M1
		Obtain $a = 2$ and $b = \frac{-5}{2}$	A1
		Obtain $c = \frac{-31}{2}$	A1
		State $\left(\frac{5}{2}, \frac{-31}{2}\right)$	A1
	(ii)	Use quadratic formula in x^2	M1
		Obtain $x^2 = \frac{9}{4}$ and $x^2 = 1$	A1
		Obtain $x = \pm\frac{3}{2}$ and $x = \pm 1$	A1
5	**(i)**	$P = 2r + 2rx$	B1
		$A = r^2x$	B1
	(ii)	$P = 20$ implies $r = \frac{10}{1+x}$	M1
		so $A = \left(\frac{10}{1+x}\right)^2 x = \frac{100x}{(1+x)^2}$ AG	A1
	(iii)	Use quotient rule	M1
		$\frac{\mathrm{d}A}{\mathrm{d}x} = \frac{100(1+x)^2 - 200x(1+x)}{(1+x)^4} = \frac{100(1-x)}{(1+x)^3}$	A1
		Set equal to zero and find $x = 1$	A1
		Show with first differential test that it is maximum. o.e.	M1 A1
6	**(i)**	Attempt to solve $c = 1$ for at least one drug, and obtain a solution	M1
		Obtain 54.9 (hours) for Antiflu	A1
		Obtain 23.0 (hours) for Coldcure	A1
	(ii)	Two *decaying* exponentials in the first quadrant	B1
		Correct intercepts on the c-axis	B1
		Crossing over at a value of $t < 23$	B1
	(iii)	Assume additive nature of the concentrations	M1
		$5e^{-0.07\times 30} + 5e^{-0.07\times 10} = 3.10$	A1

7		Separate variable prior to integration	M1
		$\int \frac{1}{\sec y}\,dy = \int \frac{1}{x^2}\,dx$	A1
		$\sin y = -\frac{1}{x} \quad (+c)$	A1
		Substitute in $y = \frac{\pi}{6}$ and $x = 4$ to get $c = \frac{3}{4}$	M1 A1
		$y = \sin^{-1}\left(\frac{3}{4} - \frac{1}{x}\right)$ o.e.	A1
8	**(i)**	Either $\frac{dy}{dt} = 2e^{2t} - 3$ or $\frac{dx}{dt} = 2e^{2t} - 5$	B1
		$\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$ used	M1
		$= \frac{2e^{2t} - 3}{2e^{2t} - 5}$	A1
	(ii)	Substitute $t = 0$ to obtain gradient = $\frac{-1}{-3}$ or equivalent	B1
		Obtain $x = 1$	B1
		Obtain $y = 1$	B1
		Form equation of a straight line	M1
		Obtain $3y - x = 2$	A1
9	**(i)**	Find **a** – **b** or **b** – **a**	M1
		Use correct method to find the magnitude of any vector	M1
		$\sqrt{154}$ or equivalent	A1
	(ii)	Attempt $\cos\theta = \frac{\overrightarrow{AO}.\overrightarrow{AB}}{\lvert\overrightarrow{AO}\rvert\lvert\overrightarrow{AB}\rvert}$	M1
		Obtain 70 anywhere	B1
		Obtain $\frac{70}{\sqrt{45}\sqrt{154}}$	A1
		Obtain 32.8°	A1

10	**(i)**	Attempt to use product rule	M1
		$y' = ae^{ax}\cos bx - be^{ax}\sin bx$	A1
		Set $y' = 0$ and rearrange	M1
		$\tan bx = \frac{a}{b}$ validly obtained	A1
	(ii)	<u>Model 1</u> Correct method to solve $\tan 15x = -\frac{1}{15} \Rightarrow x = -0.00444.....$	M1
		Obtain $y = 1.0022$	A1
		Correct method to solve $x + \frac{\pi}{15} = 0.20499$	M1
		Obtain $y = -0.81284$	A1
		State when $x = 0.3$ $y = -0.156$	B1
		<u>Model 2</u> Obtain $f + g = 1$	B1
		Obtain $-f + g = -0.8$	B1
		Attempt to solve *their* equations simultaneously	M1ft
		Obtain $f = 0.9$, $g = 0.1$	A1
		Obtain $\lambda = 5\pi$	B1
		State when $x = 0.3$, $y = 0.1$	B1
		Relevant comment that model 2 matches experimental data more closely.	B1