



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

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

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

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 $\tan 15x = -\frac{1}{15} \Rightarrow x = -0.00444\dots$	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 <i>their</i> 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		