

MARK SCHEME for the October/November 2013 series

0606 ADDITIONAL MATHEMATICS

0606/23

Paper 2, maximum raw mark 80

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

Page 2	Mark Scheme	Syllabus	Paper
	IGCSE – October/November 2013	0606	23

Mark Scheme Notes

Marks are of the following three types:

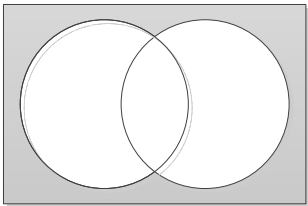
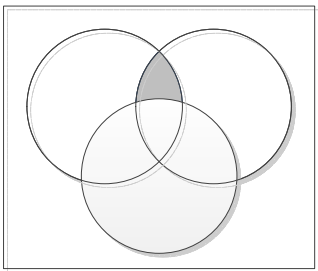
M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea 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).

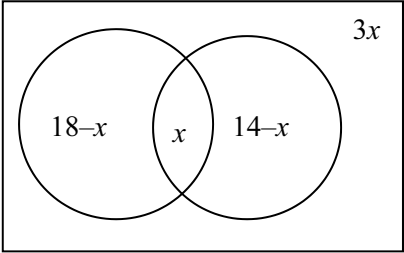
B Accuracy mark for a correct result or statement independent of method marks.

- When a part of a question has two or more “method” steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB (or dep*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.
- The symbol $\surd$ implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously “correct” answers or results obtained from incorrect working.
- Note: B2 or A2 means that the candidate can earn 2 or 0.
B2, 1, 0 means that the candidate can earn anything from 0 to 2.

Page 3	Mark Scheme	Syllabus	Paper
	IGCSE – October/November 2013	0606	23

1	$\frac{dy}{dx} = 3x^2 - 12x - 36$ Equate to 0 and solve 3 term quadratic $x = -2$ and $x = 6$ $y = 56$ and $y = -200$	B2, 1, 0 M1 A1 A1 [5]	Allow B1 if 2 terms correct Or one coordinate pair For two y values
2 (a) (i)	840	B1 [1]	
(ii)	480	B1 [1]	
(iii)	Calculates any case(s) correctly Partitions all cases correctly 140	B1 M1 A1 [3]	e.g. $1 \times 5 \times 4 \times 3 = 60$, $1 \times 5 \times 4 \times 4 = 80$
3	Eliminate x or y Obtain $kx^2 + 8x + k - 6 (= 0)$ Use $b^2 - 4ac \geq 0$ Obtain $-4k^2 + 24k + 64 \geq 0$ oe Solve 3 term quadratic ($k = 2, 8$) $k < -2, k > 8$	M1* A1 DM1 A1 M1 A1 [1]	
4 (a) (i)	$A = 3, B = 2$	B1, B1	
(ii)	$C = 4$	B1	
(b)	120 or $\frac{2\pi}{3}$ 5	B1 B1	
5 (a) (i)		B1 [1]	
(ii)		B1 [1]	
(b)	$S \cap T'$ or $(S' \cup T)'$ oe	B1 [1]	Others will be seen but only accept completely correct set notation

Page 4	Mark Scheme	Syllabus	Paper
	IGCSE – October/November 2013	0606	23

(c)	 $18 - x + x + 14 - x + 3x = 40$ $x = 4$	B1 M1 A1 [3]	B1 for any two of x, $3x$, $18 - x$ or $14 - x$ in correct place (or implied by correct equation)
6 (a) (i)	Equate $f(-3)$ to zero Equate $f(2)$ to 65 $-54 + 9a - 3b + 21 = 0$ ($9a - 3b = 33$) or $16 + 4a + 2b + 21 = 65$ ($4a + 2b = 28$) Solve simultaneous equations $a = 5, b = 4$	M1 M1 A1 M1 A1 [5]	
(ii)	Calculate $f\left(-\frac{1}{2}\right) = -\frac{1}{4} + \frac{a}{4} - \frac{b}{2} + 21$ 20	M1 A1 [2]	Or use long division
7	Eliminate x or y Rearrange to quadratic in x or y correctly $x^2 - 10x + 16 (= 0)$ or $y^2 + 8y - 128 (= 0)$ oe Solve 3 term quadratic $x = 2, x = 8$ $y = 8, y = -16$ Correct method for at least one coordinate of C $C(4, 0)$	M1 M1 A1 M1 A1 A1 M1 A1 [8]	Or one correct coordinate pair e.g. $x_c = \frac{1}{3} [2(2) + 1(8)]$, $\mathbf{OC} = \mathbf{OA} + \frac{1}{3} \mathbf{AB}$ oe

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	IGCSE – October/November 2013	0606	23

8	(a) (i)	$X(14, 12)$ $m_{AX} = \frac{1}{3}$ Use $m_1 m_2 = -1$ for grad CD from grad AX CD is $y - 4 = -3(x - 10)$ or $y = -3x + 34$ AX is $y - 6 = \frac{1}{3}(x + 4)$ or $3y - x = 22$ Solve eqn for CD with eqn for AX $D(8, 10)$	B1 B1 M1 A1√ B1√ M1 A1 [7]	√ on grad AX √ on grad AX
	(ii)	Method for area 100	M1 A1 [2]	
9	(a) (i)	9	B1 [1]	
	(ii)	$a = k \cos 2t$ $12 \cos 2t$ -7.84	M1 A1 A1√ [3]	No other functions of t or constants √ on k only Must be negative (if correct) or say “deceleration”
	(iii)	$t = \frac{7\pi}{12}$ or awrt 1.8 $3t - 3 \cos 2t$ Use limits of 0 and their $\left(\frac{7\pi}{12}\right)$ or finds $c (\neq 0)$ and substitutes their $\left(\frac{7\pi}{12}\right)$ 11.1 or $\frac{7\pi}{4} + \frac{3\sqrt{3}}{2} + 3$	B1 B1, B1 M1 A1 [5]	Upper limit must be positive

Page 6	Mark Scheme	Syllabus	Paper
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10 (a) (i)	Radius is $\frac{h}{4}$	B1	On water cone
	Use $\frac{1}{3} \pi r^2 h$	M1	
	$\frac{1}{3} \pi \left(\frac{h}{4}\right)^2 \times h \left(= \frac{\pi h^3}{48}\right)$	A1 ag [3]	
	(ii) $\frac{dV}{dh} = \frac{\pi h^2}{16}$	B1	
(iii)	Use $\frac{dh}{dt} = \frac{dV}{dt} \times \frac{dV}{dh}$		
	with $h = 50$, $\frac{dV}{dt} = 20\pi$	M1	
	0.128	A1 [3]	
	(iii) $A = \frac{\pi h^2}{16}$ $\frac{dA}{dh} = \frac{\pi h}{8}$	B1 M1	
	Use $\frac{dA}{dt} = \frac{dh}{dt} \times \frac{dA}{dh}$ with substitution of $h = 50$, their 0.128	M1	
	0.8π or 2.51	A1 [3]	
11 (a) (i)	$(2\mathbf{i} + 4\mathbf{j})t$	B1	Or use $t = 2$ to find position vectors of A, B $4\mathbf{i} + 8\mathbf{j}$, $-11\mathbf{i} + 28\mathbf{j}$
	$(-21\mathbf{i} + 22\mathbf{j}) + (5\mathbf{i} + 3\mathbf{j})t$	B1 [2]	
	(ii) Subtract position vectors $((-21 + 3t)\mathbf{i} + (22 - t)\mathbf{j})$	M1	
	Substitute $t = 2$ and use Pythagoras Correctly reach 25	M1 A1 [3]	
(iii)	$(-21 + 3t)^2 + (22 - t)^2 = 25^2$ oe	M1	Set expression for distance apart to 25
	$t^2 - 17t + 30 (= 0)$	A1	
	Solve 3 term quadratic	M1	Not essential to solve quadratic
	$t = 15$ (and 2)	A1	e.g. $t_1 + t_2 = 17$ and $t_1 = 2$
	13 hours	A1 [5]	