CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

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.

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.

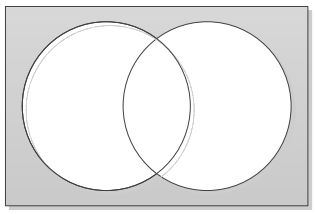
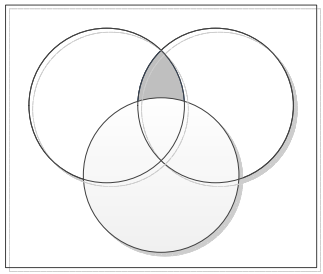
A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

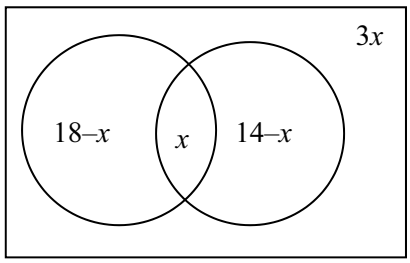
B Accuracy mark for a correct result or statement independent of method marks.

- 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 √ 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.

1		$\frac{dy}{dx} = 3x^2 - 12x - 36$	B2, 1, 0	Allow B1 if 2 terms correct
		Equate to 0 and solve 3 term quadratic	M1	
		$x = -2$ and $x = 6$	A1	Or one coordinate pair
		$y = 56$ and $y = -200$	A1 [5]	For two y values
2	**(a) (i)**	840	B1 [1]	
	(ii)	480	B1 [1]	
	(iii)	Calculates any case(s) correctly	B1	e.g. $1 \times 5 \times 4 \times 3 = 60$, $1 \times 5 \times 4 \times 4 = 80$
		Partitions all cases correctly	M1	
		140	A1 [3]	
3		Eliminate x or y	M1*	
		Obtain $kx^2 + 8x + k - 6$ (= 0)	A1	
		Use $b^2 - 4ac$*0	DM1	
		Obtain $-4k^2 + 24k + 64$*0 oe	A1	
		Solve 3 term quadratic ($k = 2, 8$)	M1	
		$k < -2$, $k > 8$	A1 [1]	
4	**(a) (i)**	$A = 3$, $B = 2$	B1, B1	
	(ii)	$C = 4$	B1	
	(b)	120 or $\frac{2\pi}{3}$	B1	
		5	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

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

8	**(a) (i)**	X (14, 12)	B1	
		$m_{AX} = \frac{1}{3}$	B1	
		Use $m_1m_2 = -1$ for grad CD from grad AX	M1	
		CD is $y - 4 = -3(x - 10)$ or $y = -3x + 34$	A1√	√ on grad AX
		AX is $y - 6 = \frac{1}{3}(x + 4)$ or $3y - x = 22$	B1√	√ on grad AX
		Solve eqn for CD with eqn for AX	M1	
		D (8, 10)	A1 [7]	
	(ii)	Method for area	M1	
		100	A1 [2]	
9	**(a) (i)**	9	B1 [1]	
	(ii)	$a = k \cos 2t$	M1	No other functions of t or constants
		$12 \cos 2t$	A1	
		-7.84	A1√ [3]	√ on k **only** Must be negative (if correct) or say "deceleration"
	(iii)	$t = \frac{7\pi}{12}$ or awrt 1.8	B1	
		$3t - 3 \cos 2t$	B1, B1	
		Use limits of 0 and their $\left(\frac{7\pi}{12}\right)$ or finds c ($\neq 0$) and substitutes their $\left(\frac{7\pi}{12}\right)$	M1	Upper limit must be positive
		11.1 or $\frac{7\pi}{4} + \frac{3\sqrt{3}}{2} + 3$	A1 [5]	

10 (a) (i)	Radius is $\frac{h}{4}$	B1	
	Use $\frac{1}{3}\pi r^2 h$	M1	On water cone
	$\frac{1}{3}\pi\left(\frac{h}{4}\right)^2 \times h \left(=\frac{\pi h^3}{48}\right)$	A1**ag** [3]	
(ii)	$\frac{dV}{dh}=\frac{\pi h^2}{16}$	B1	
	Use $\frac{dh}{dt}=\frac{dV}{dt}\times\frac{dh}{dV}$		
	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	
	$(-21\mathbf{i} + 22\mathbf{j}) + (5\mathbf{i} + 3\mathbf{j})t$	B1 [2]	
(ii)	Subtract position vectors $((-21+3t)\mathbf{i}+(22-t)\mathbf{j})$	M1	Or use $t = 2$ to find position vectors of A, B $4\mathbf{i} + 8\mathbf{j}$, $-11\mathbf{i} + 28\mathbf{j}$
	Substitute $t = 2$ and use Pythagoras Correctly reach 25	M1 A1 [3]	Subtract position vectors and use Pythagoras
(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]	