UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

0580 MATHEMATICS

0580/04 Paper 4 (Extended), maximum raw mark 130

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UNIVERSITY of CAMBRIDGE
International Examinations

Abbreviations

cao correct answer only
cso correct solution only
dep dependent
ft follow through
isw ignore subsequent working
oe or equivalent
SC Special Case
soi seen or implied
www without wrong working

1 (a) (i)	**8.4(0)**	**B2**	**B1** for 1.2 or 3.6 seen or **SC1** for figs 84 in answer
(ii)	$\frac{\textit{their}\textbf{(i)}}{20} \times 100$ oe **42** ft www2	**M1** **A1ft**	ft their 8.4 × 5 After 0 scored **SC1 ft** for 58% or $\frac{20 - \textit{their}\textbf{(i)}}{20} \times 100$ correctly given
(b)	**6**	**B2**	**M1** for 9 or 8 ÷ (1 + 8 + 3) soi
(c)	$\frac{2.4}{2} \times 3$ oe (= 3.6 seen) or their **(a) (i)** ÷ 7 × 3 $\frac{3}{12} \times 9$ oe (= 2.25 seen) **1.6(0)** cao www3	**M1** **M1** **A1**	
(d)	$\frac{2.40}{1.25}$ oe **1.92** www2	**M1** **A1**	Implied by figs 192 **[11]**

2 (a) (i)	Reflection (M), $x = 1$	**B1,B1**	If extra transformations given in part **(a)** then zero scored
(ii)	Rotation (R) 180 (centre) (1, 0)	**B1** **B1** **B1**	Must be "rotation". Allow half turn for 180. Allow other clear forms of (1, 0)
(iii)	Enlargement (E) (centre) (6, 4) (scale factor) 3	**B1** **B1** **B1**	Must be "enlargement" Allow other clear forms of (6, 4) e.g. vector Accept 3 : 1 or 1 : 3
(iv)	Shear (H) *y*-axis invariant oe (factor) –1	**B1** **B1** **B1**	Must be "shear" Allow other explanation for invariant but not "parallel to" isw after *y*-axis invariant seen

(b) (i)	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	**B2**	**B1** for correct right–hand column in 2 by 2 matrix
(ii)	$\begin{pmatrix} 1 & 0 \\ -1ft & 1 \end{pmatrix}$	**B2ft**	Ft only their factor in **(a) (iv)** provided not zero **B1ft** for left-hand column in 2 by 2 matrix provided shear factor is not zero or **SC1** for $\begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$ if not ft **[15]**

3 (a) (i)	**1**	**B1**	Penalty of –1 in question if any answers given as decimals or percentages (to 3sf) alone, but isw cancelling/conversion after correct answer
(ii)	$3/6$ oe	**B1**	
(b) (i)	$\frac{2}{30}$ oe www2	**B2**	**M1** for $\frac{2}{6} \times \frac{1}{5}$
(ii)	6–12 and 12–6 and 7–11 and 11–7 soi $k \times \frac{1}{6} \times \frac{1}{5}$ for k = integer $\frac{4}{30}$ oe www3	**M1** **M1** **A1**	Evidence of all pairs adding up to 18 but no extras e.g. 4/6 × 1/6 Without seeing the first M, $\frac{4}{6} \times \frac{1}{5}$ oe scores **M2**, $\frac{2}{6} \times \frac{1}{5}$ oe scores **M1**
(iii)	$\frac{4}{6} \times \frac{2}{5}$ $\frac{8}{30}$ oe www2	**M1** **A1**	
(c)	$\frac{2}{6} + \frac{4}{6} \times \frac{2}{5}$ oe $\frac{18}{30}$ oe cao www2	**M1** **A1**	$\frac{2}{6}$ + their **(b) (iii)**
(d)	**4**	**B2**	**M1** for $(1 + 1 + 6 + 7 + 11 + 12 + x) \div 7 = 6$ or better **[13]**

4 (a) (i)	Accurate triangle with 2 arcs seen, 2 mm accuracy for lines AC and BC	**B2**	**SC1** if accurate but no arcs or one arc or if AC and BC are wrong way round with arcs
(ii)	Accurate bisector of angle ***ACB***, 2° accuracy and both pairs of arcs shown (accept equidistant marks on edges for 1st set of arcs) + must meet *AB*	**B2ft**	Ft their triangle **SC1ft** if accurate but no/one pair of arcs or short with arcs In both **(ii)** and **(iii)** isw
(iii)	Accurate perpendicular bisector of ***AD*** 2 mm accuracy at mid-point and 2° for right angle and shows both sets of arcs + must meet *AC*	**B2ft**	ft their *D*, which must be on *AB* **SC1ft** if accurate but no/one pair of arcs or short with arcs
(iv)	Correct region shaded cao	**B1**	Dependent on correct triangle, accurate bisectors of angle *ACB* and side *AD* with correct *D*
(b) (i)	$(\cos C) = \dfrac{140^2 + 180^2 - 240^2}{2 \times 140 \times 180}$ oe **– 0.111(1)…or better or 96.37 to 96.38**	**M2** **E1**	(–5600/50400 or –14/126) Allow use of 7, 9 and 12 **M1** for correct implicit statement Verification using 96.4 scores **M2** max Accept $-\frac{1}{9}$ but not a non-reduced fraction
(ii)	0.5 × 140 × 180 sin (their 96.4) oe **12521 to 12523 or 12 500 or 12520** cao www2	**M1** **A1**	(s = 280), allow use of 7, 9 (31.3…)
(iii)	(Sin *B* =) $\dfrac{140\sin(\textit{their}\,96.4)}{240}$ oe **35.4** or **35.42 to 35.44** cao www3	**M2** **A1**	Allow use of 7, 12 **M1** for correct implicit statement **SC2** for correct answer by other method **[15]**

5 (a) (i)	$(x + 3)(2x + 5) – x(x + 4) = 59$ oe $2x^2 + 6x + 5x + 15 – x^2 – 4x = 59$ oe $x^2 + 7x – 44 = 0$	**M1** **A1** **E1**	Implies **M1** (allow $11x$ for $6x + 5x$) Correct conclusion – no errors or omissions
(ii)	$(x + 11)(x – 4)$	**B2**	**SC1** any other $(x + a)(x + b)$ where $a \times b = – 44$ or $a + b = 7$
(iii)	**–11, 4** www ft	**B1ft**	Strict ft dep on at least **SC1** in **(ii)** allow recovery if new working seen
(iv)	$\tan = \dfrac{(\textit{their} + \textit{ve root}) + 3}{2(\textit{their} + \textit{ve root}) + 5}$ oe **28.3** (00…) ft www2	**M1** **A1ft**	Could be alt trig method oe **M1** where trig function is explicit ft one of their positive roots (27.4° (27.40 – 27.41) from $x = 11$)

(b) (i)	$\frac{2x+5}{x+4} = \frac{x+3}{x}$ oe $x^2 + 4x + 3x + 12 = 2x^2 + 5x$ $x^2 - 2x - 12 = 0$	**M1** **A1** **E1**	Must be seen. Allow ratio or correct products Correct expansion of brackets seen (allow $7x$ for $4x + 3x$) Correct conclusion – no errors or omissions **M1** must be seen
(ii)	$\frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-12)}}{2(1)}$ or $(x-1)^2 - 12 - 1$ (B1) and $x - 1 = \pm\sqrt{13}$ (B1) **– 2.61, 4.61 final answers** www4	**B1,B1** **B1,B1**	In square root **B1** for $(-2)^2 - 4(1)(-12)$ or better If in form $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$, **B1** for – (–2) and 2(1) or better If B0, **SC1** for –2.6 **and** 4.6 or **both** answers correct to 2 or more dps rot – 2.6055…, 4.6055….
(iii)	**26.4 (26.42…. to 26.44….)** ft	**B1ft**	ft 4 × a positive root + 8 **[16]**

6 (a) (i)	**–16**	**B1**	
(ii)	**18 to 19**	**B1**	
(b) (i)	**–4.3 to –4.2, 1.5 to 1.6**	**B1,B1**	
(ii)	**–4.5 to –4.4 , 1.3 to 1.4**	**B1,B1**	
(iii)	**–4.5 to –4.4** $< x <$ **1.3 to 1.4** ft	**B1ft**	Ft their **(ii)**. Allow clear worded explanations and condone ≤ signs
(c)	$-\frac{30}{7}$ oe isw conversion	**B2**	Accept $-4\frac{2}{7}$, 30/–7 **M1** for 30/7 oe fracts, isw conversion **or** for –30/7 oe soi
(d)	Ruled line passing within 2 mm of (–5, 30) and (2, 0)	**B2**	**B1** for ruled line parallel to g(x). By eye (21° to 25° to horizontal if in doubt) allow broken line
(e) (i)	Ruled horizontal line through (–3, –27)	**B1**	No daylight, not chord (allow broken)
(ii)	$y = -27$	**B1**	
(f)	Ruled lines $x = -3$, $x = -2$, $y = 40$ Region enclosed by lines $x = -3$, $x = -2$, $y = 40$ and $y = g(x)$	**B1** **B1**	Long enough to be boundary of region – allow broken or solid ruled lines Allow any clear indication **[15]**

7 (a) (i)	$\frac{60}{360} \times \pi \times 2 \times 24$ oe **25.1 (25.12 to 25.14)** www2	**M1** **A1**	Accept 8π
(ii)	$\frac{60}{360} \times \pi \times 24^2$ oe **301 or 302 or 301.4 to 301.7** www2	**M1** **A1**	Accept 96π
(b) (i)	πd = *their* **(a) (i)** oe **4 (3.99 – 4.01)** cao www2	**M1** **A1**	
(ii)	24^2 – (their radius)^2 **23.7 (23.66 to 23.67)** cao www2	**M1** **A1**	Alt trig method for h explicit Accept $\sqrt{560}, 2\sqrt{140}, 4\sqrt{35}$
(iii)	$\frac{1}{3} \times \pi \times$ (their r)$^2 \times$ (their h) **394 – 398** cao www2	**M1** **A1**	Not for $h = 24$
(c) (i)	**27*W***	**B1**	
(ii)	**4*W***	**B1**	If B0, B0 in (c), **SC1** for 27 and 4 alone **[12]**

8 (a)	**$5.5 < t \leqslant 6$**	**B1**	Condone poor notation
(b)	4.25, 4.75, 5.25, 5.75, 6.25, 6.75 $(2 \times 4.25 + 7 \times 4.75 + 8 \times 5.25 + 18 \times 5.75 + 10 \times 6.25 + 5 \times 6.75)$ (= 283.5) $\div 50$ or their $\sum f$ **5.67** www4	**M1** **M1** **M1** **A1**	At least 5 correct mid-values seen $\sum fx$ where x is in the correct interval allow one further slip Depend on second method After **M3** allow 5.7 isw conversion to mins/secs and reference to classes
(c) (i)	**17, 15**	**B1**	
(ii)	Rectangular bars of heights **11.3** and **15** Correct widths of 1.5 and 1 – no gaps	**B1ft** **B1ft** **B1**	ft their 17 divided by 1.5 ft their 15 11.3 plot between 11 and 12 include lines and 15 to be touching the 15 line
(iii)	**2.5** cao	**B1**	**[10]**

9 (a)	$3(m-3)+4(m+4)=-7\times12$ $3m-9+4m+16=-84$ **–13** www4	**M2** **A1** **A1**	Allow all over 12 at this stage **M1** for $3(m-3)+4(m+4)$ seen Allow all over 12 at this stage May be seen in stages
(b) (i)	0.5 oe	**B1**	
(ii)	$\frac{3(x+3)-2(x-1)}{(x-1)(x+3)}$ $\frac{x+11}{(x-1)(x+3)}$ final answer	**M1** **A1**	If brackets not seen allow $3x + 9 - 2x \pm 2$ as numerator with a correct denominator isw incorrect expansion of denominator if correct brackets seen
(iii)	$\frac{x(x+11)}{(x-1)(x+3)}=1$ ft **or** $x+11=\frac{1}{x}(x-1)(x+3)$ or better ft $x^2+11x=x^2+3x-x-3$ $-\frac{1}{3}$ oe cso www3	**M1** **M1** **A1**	Must clear one denominator correctly Ft their **(b)(ii)** dep on fraction in **(ii)** with $(x-1)(x+3)$ oe as denominator Depend on previous **M1** – 0.33(33…)
(c)	$p(q-1)=t$ oe $pq=t+p$ $\frac{t+p}{p}$ oe final answer www3	**M1** **M1** **M1**	Multiplying by $(q-1)$ Ft their first step e.g. pq only term on one side Ft their 2nd step e.g. dividing by p Note: $q-1=\frac{t}{p}$ is **M2** and then $q=\frac{t}{p}+1$ is **M1** **[13]**

10 (a)	$21+23+25+27+29=125$ $31+33+35+37+39+41=216$	**B1** **B1**	
(b)	Cubes	**B1**	
(c) (i)	n oe	**B1**	
(ii)	n^3 oe	**B1**	
(d)	$4^2-4+1=13$ www	**E1**	Allow 16 for 4^2, otherwise all must be seen
(e)	$7\times43+2+4+6+8+10+12$	**B1**	All must be seen
(f)	$n(n-1)$ final answer oe	**B1**	
(g)	$n(n^2-n+1)$ + their **(f)** $n^3-n^2+n+n^2-n=n^3$	**M1** **E1**	All must be seen, no errors or omissions **[10]**