

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

0581 MATHEMATICS

0581/04

Paper 4 (Extended), maximum raw mark 130

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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)	$\frac{\text{their(i)}}{20} \times 100$ oe 42 ft www2	M1 A1ft	ft their 8.4×5 After 0 scored SC1 ft for 58% or $\frac{20 - \text{their(i)}}{20} \times 100$ correctly given
(b)	6	B2	M1 for 9 or $8 \div (1 + 8 + 3)$ soi
(c)	$\frac{2.4}{2} \times 3$ oe (= 3.6 seen) or their (a) (i) $\div 7 \times 3$ $\frac{3}{12} \times 9$ 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

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(b) (i)	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	B2	B1 for correct right-hand column 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

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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)	$\frac{3}{6}$ 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 $k = \text{integer}$ $\frac{4}{30}$ oe www3	M1 M1 A1	Evidence of all pairs adding up to 18 but no extras e.g. $4/6 \times 1/6$ 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

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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 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 1 st 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)	$(\cos C) = \frac{140^2 + 180^2 - 240^2}{2 \times 140 \times 180}$ 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)	$0.5 \times 140 \times 180 \sin$ (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)	$(\sin B =) \frac{140 \sin(\text{their } 96.4)}{240}$ 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

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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)	$\tan = \frac{(\text{their} + \text{ve root}) + 3}{2(\text{their} + \text{ve root}) + 5}$ 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 $x = 11$)

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(b) (i)	$\frac{2x+5}{x+4} = \frac{x+3}{x} \quad \text{oe}$ $x^2 + 4x + 3x + 12 = 2x^2 + 5x$ $x^2 - 2x - 12 = 0$	M1 Must be seen. Allow ratio or correct p A1 Correct expansion of brackets seen (allow E1 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 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 B1,B1 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 $4 \times$ a positive root + 8

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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 \leq 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

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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)	$\pi d = \text{their (a) (i)}$ oe 4 (3.99 – 4.01) cao www2	M1 A1	
(ii)	$24^2 - (\text{their radius})^2$ 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)	$\frac{1}{3} \times \pi \times (\text{their } r)^2 \times (\text{their } h)$ 394 – 398 cao www2	M1 A1	Not for $h = 24$
(c) (i)	27W	B1	
(ii)	4W	B1	If B0, B0 in (c), SC1 for 27 and 4 alone
			[12]

8 (a)	$5.5 < t \leq 6$	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)	$3(m-3) + 4(m+4) = -7 \times 12$ $3m - 9 + 4m + 16 = -84$ -13 www4	M2 A1 A1	Allow <u>all over</u> 12 at this stage M1 for $3(m-3) + 4(m+4)$ seen Allow <u>all over</u> 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 A1 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 $-0.33(33\dots)$
(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 2 nd step e.g. dividing by p Note: $q-1 = \frac{t}{p}$ is M2 and then $q = \frac{t}{p} + 1$ is M1

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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)	$7 \times 43 + 2 + 4 + 6 + 8 + 10 + 12$	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

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