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Paper 2C Core Tier

Mark scheme

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2 2 6 Y 9 2 6 0 / 2 C / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

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Key to mark types and abbreviations

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq \text{value} < b$
3.14 ...	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Q	Answer	Mark	Comments
1	8 min 20 s	B1	

Q	Answer	Mark	Comments
2	10^6	B1	

Q	Answer	Mark	Comments
3	$\frac{1}{6}$	B1	

Q	Answer	Mark	Comments
4	1976	B1	

Q	Answer	Mark	Comments
5	All four 4 correct	B3	B2 2 or 3 correct B1 1 correct
	Additional Guidance		
			B3
	2 lines from one left-hand expression is choice		

Q	Answer	Mark	Comments
6(a)	$(-1, 1)$	B1	

Q	Answer	Mark	Comments
6(b)	C plotted at $(-4, -3)$	B2	B1 C plotted at $(2, 5)$ or C plotted with y -coordinate -3
	Additional Guidance		
	Condone unlabelled point if intention clear		

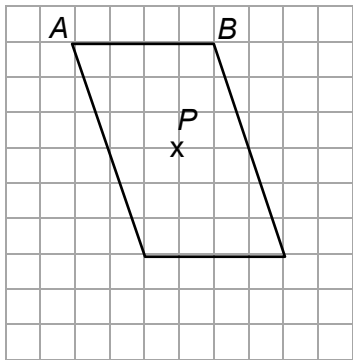
Q	Answer	Mark	Comments
7	Alternative method 1		
	$36 \div 3$ or 12 or $36 \div 8$ or 4.5	M1	
	$36 \div 3 \div 8$ or 1.5	M1dep	oe
	11	A1	
	Alternative method 2		
	$3 \times 8 \times x$ or $24x$	M1	oe any letter
	$36 \div (3 \times 8)$ or $36 \div 24$ or 1.5	M1dep	oe
	11	A1	
	Additional Guidance		
	$8 + 2 + 2 = 12$		M0
	$36^2 \div 8^2$		M0

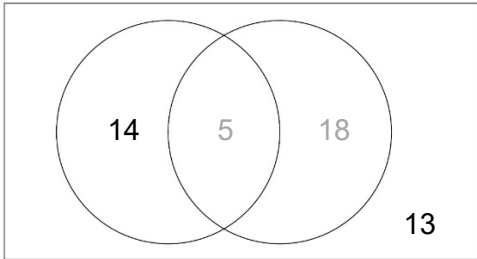
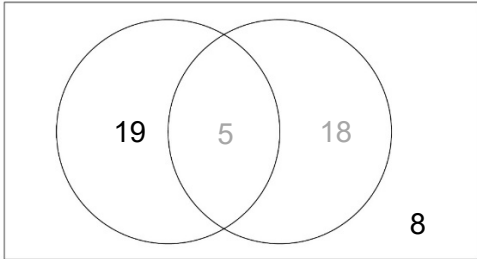
Q	Answer	Mark	Comments
8(a)	34	B1	

Q	Answer	Mark	Comments
8(b)	Alternative method 1		
	$4n = 90 - 14$ or $(90 - 14) \div 4$ or 19 or $4m = 90 - \text{their } 34$ or $(90 - \text{their } 34) \div 4$ or 14 or $4p + 10 = 90$ or $(90 - 10) \div 4$	M1	oe eg $4n = 76$ $4(p - 1) = 90 - 14$ $4(p - 6) = 90 - \text{their } 34$ n is the number of days after day 1 m is the number of days after day 6 p is the number of the day any letter ft their (a) provided it is less than 90
	20	A1ft	ft their (a) provided it is less than 90 and gives an integer answer
	Alternative method 2		
	Adds on 4s to 14 or adds on 4s to their 34	M1	total must be within 4 of 90 with at most 1 error ft their (a)
	20	A1ft	ft their (a) provided it is less than 90 and gives an integer answer
	Additional Guidance		
	In alt 2, an error may be one incorrect total in one of the additions of 4 or one incorrect count of the number of 4s being added on, eg day 10 = 50 day 12 = 54		
	38 minutes in (a) and 38 minutes used in (b) with answer 19 days		M1A1ft
	38 minutes in (a) and $(90 - 14) \div 4 = 19$ in (b) Answer 19		M1A0
	$14 + 4 \times 19 = 90$		M1

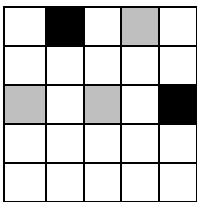
Q	Answer	Mark	Comments
9	Alternative method 1		
	$10 \div 5$ or 2	M1	oe
	-1	A1	SC1 -5 or 1.4 oe or 5 or 47
	Alternative method 2		
	$(x + 3) \times 5 = 10$ or $x = \frac{10}{5} - 3$	M1	oe any letter condone missing brackets
	-1	A1	SC1 -5 or 1.4 oe or 5 or 47
	Additional Guidance		
	$(-1 + 3) \times 5 = 10$ without -1 selected		M1A0

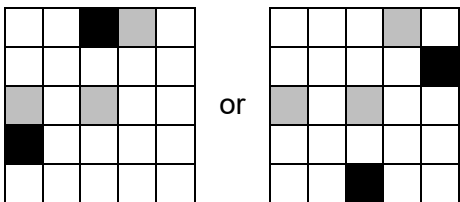
Q	Answer	Mark	Comments
10	ET EJ EW CT CJ CW ST SJ SW with no errors or repeats	B2	any configuration B1 5 or 6 new combinations accept words
	Additional Guidance		
	Letters can be written in either order, eg EJ can be written JE		
	Ignore repeats and errors for B1		
	JE and EJ is a repeat		
	Allow ET to be written again if list restarted		

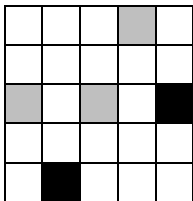
Q	Answer	Mark	Comments
11		B2	B1 one of the bottom vertices correct or any non-right-angled parallelogram drawn with AB as one side
	Additional Guidance		
	Rectangle or square		B0

Q	Answer	Mark	Comments
12(a)	14 in correct section	B1	
	13 in correct section	B1ft	ft 50 – 5 – 18 – their 14 with their 14 an integer in the range $[1, 27]$
	Additional Guidance		
	If their 14 is 27, then 0 must be written outside the circles		
			B2
			B0B1ft

Q	Answer	Mark	Comments
12(b)	$\frac{23}{50}$	B1	oe decimal, fraction or percentage
	Additional Guidance		
	Ignore any incorrect cancelling or attempt to change to a decimal or percentage once correct fraction seen		

Q	Answer	Mark	Comments
13(a)		B1	

Q	Answer	Mark	Comments
13(b)		B1	

Q	Answer	Mark	Comments
13(c)		B1	

Q	Answer	Mark	Comments
14	3×8 or 24 or $3 \div 4$ or $4 \div 3$ or $8 \div 4$ or $4 \div 8$	M1	oe
	6	A1	
	Additional Guidance		
	$3 \times 8 \div 4$ oe		M1

Q	Answer	Mark	Comments
15(a)	67 occurs the most	B1	oe
	Additional Guidance		
	67 occurs three times		B1
	It appears three times		B1
	7 occurs three times		B0
	67 repeats		B0
	67 is in the middle		B0

Q	Answer	Mark	Comments
15(b)	$81 - 45 (= 36)$ or $81 - 36 = 45$ or $45 + 36 = 81$	B1	
	Additional Guidance		
	45 to 81 is 36		B1
	$45 - 81 (= 36)$		B0

Q	Answer	Mark	Comments
15(c)	67 seconds and 41 seconds or 67 seconds and 85 seconds	B2	either order B1 one correct value or 42 and 82 or 43 and 83 or 44 and 84
	Additional Guidance		
	41 and 67		B2
	67 and 41 or 85		B2
	41 and 85		B1

Q	Answer	Mark	Comments
16	4, 5, 6, 7, 8	B2	B1 5 values with at most 1 incorrect value or 3 or 4 correct values with no incorrect values or $x > 4 - 1$ or $x > 3$ or $x \geq 4$ or $x \leq 16 \div 2$ or $x \leq 8$ or $x < 9$ or $3 < x \leq 8$ or $4 \leq x < 9$ or $3 < x < 9$ or $4 \leq x \leq 8$
	Additional Guidance		
	3, 4, 5, 6, 7, 8		B1
	4, 5, 6, 7		B1
	6, 7, 8		B1
	$3 < x \leq 8$ represented on a number line		B1

Q	Answer	Mark	Comments
17	Alternative method 1		
	Lists multiples of 12 and 20 as far as 60 or lists prime factors of 12 and 20 or states any multiple of 60	M1	12, 24, 36, 48, 60 20, 40, 60 or (12 =) $2 \times 2 \times 3$ (20 =) $2 \times 2 \times 5$ or 120 or 240 or ...
	60	A1	implied by 5 packs of cards and 3 packs of envelopes
	their 60×3.25 or 195 or (their $60 \div 12$) $\times 4 +$ (their $60 \div 20$) $\times 2.5(0)$ or $5 \times 4 + 3 \times 2.5(0)$ or 27.5(0)	M1	their 60 must be a multiple of 60
	their $195 - \text{their } 27.5(0)$ or $195 - 27.5(0)$	M1dep	dep on M2 their 195 and their 27.5(0) must both be from correct methods
	167.5(0)	A1ft	ft their 60 if a multiple of 60

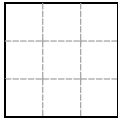
Alternative method 2 and Additional Guidance are on the next page

17 cont.	Alternative method 2		
	Lists multiples of 12 and 20 as far as 60 or lists prime factors of 12 and 20 or states any multiple of 60	M1	12, 24, 36, 48, 60 20, 40, 60 or (12 =) $2 \times 2 \times 3$ (20 =) $2 \times 2 \times 5$ or 120 or 240 or ...
	60	A1	implied by 5 packs of cards and 3 packs of envelopes
	$4 \div 12$ (+) $2.5(0) \div 20$ or $0.33\ldots$ (+) 0.125 or $[0.455, 0.46]$	M1	oe eg $\frac{11}{24}$ cost of 1 card and/or 1 envelope
	$(3.25 - (4 \div 12 + 2.5(0) \div 20)) \times \text{their } 60$	M1dep	dep on M2 their 60 must be a multiple of 60
	167.5(0)	A1ft	ft their 60 if a multiple of 60
	Additional Guidance		
	Using 120 $(120 \div 12) \times 4 + (120 \div 20) \times 2.5(0) = 55$ $120 \times 3.25 - 55$ Answer 335	M1A0 M1 M1dep A1ft	
	Using 240 $(240 \div 12) \times 4 + (240 \div 20) \times 2.5(0) = 110$ $240 \times 3.25 - 110$ Answer 670	M1A0 M1 M1dep A1ft	

Q	Answer	Mark	Comments
18(a)	Alternative method 1		
	$\frac{250}{300 + 250 + 220 + 130}$ or $\frac{250}{900}$	M1	oe fraction eg $\frac{5}{18}$
	0.27(7...) or 0.28	A1	oe percentage
	Alternative method 2		
	$0.25 \times (300 + 250 + 220 + 130)$ or 0.25×900	M1	oe
	225 (which is less than 250)	A1	
	Alternative method 3		
	$\frac{250}{300 + 250 + 220 + 130}$ or $\frac{250}{900}$	M1	oe fraction
	$\frac{250}{900}$ and $\frac{225}{900}$	A1	oe fractions with common denominator

Q	Answer	Mark	Comments
18(b)	$\frac{300}{900} \times 360$ or $\frac{52}{130} \times 300$ or $\frac{88}{220} \times 300$ or $\frac{300}{300 + 250} \times (360 - 52 - 88)$ or $\frac{250}{900} \times 360$ or $\frac{52}{130} \times 250$ or $\frac{88}{220} \times 250$ or $\frac{250}{300 + 250} \times (360 - 52 - 88)$	M1	oe eg $900 \div 360$ or 2.5 and $300 \div$ their 2.5 $360 \div 900$ or 0.4 and $300 \times$ their 0.4
	120 or 100	A1	may be implied by pie chart with angles [118°, 122°] or [98°, 102°]
	Complete pie chart labelled with Apple and Banana	A1	
	Additional Guidance		
	Angles may be indicated on diagram		
	Correct line dividing Apple and Banana must be ruled for A mark		
	Angles on pie chart drawn within tolerance but stated to be something other than 120 and 100 eg 110 and 110 cannot score the A marks		

Q	Answer	Mark	Comments
19	1, 64 and 5 or 4, 64 and 2 or 36, 27 and 7	B3	B2 1, 8 and 61 or 9, 8 and 53 or 25, 8 and 37 or 49, 8 and 13 or 64, 1 and 5 or 3 numbers with 3 of the following satisfied: square number < 50 , cube number > 1 , prime number < 10 , total = 70 B1 3 numbers with 2 of the following satisfied square number < 50 , cube number > 1 , prime number < 10 , total = 70
	Additional Guidance		
	Two numbers on an answer line is choice		
	Allow answers in index form, eg 2^2 , 4^3 and 2		B3
	Condone answer line of eg 6, 3 and 7 if $6^2 (= 36)$, $3^3 (= 27)$ and 7 seen in working or 36, 27 and 7 seen in working		B3
	49, 8 and 3		B2
	25, 27, 17		B1

Q	Answer	Mark	Comments
20(a)		B1	ignore any internal lines

Q	Answer	Mark	Comments
20(b)	15 (cubes)	M1	implied by any 3 numbers that multiply to 15
	1, 3 and 5 or 1, 1 and 15	A1	in any order
	Additional Guidance		
	2, 2.5 and 3 (implies 15)		M1

Q	Answer	Mark	Comments
21	C	B1	
	B	B1	

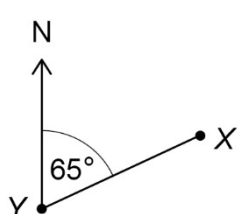
Q	Answer	Mark	Comments
22(a)	Alternative method 1		
	42 – 32 or 10	M1	
	$\frac{\text{their } 10}{32} (\times 100)$ or 0.3125 ($\times 100$)	M1dep	oe
	31.25 or 31.3	A1	accept 31 following $\frac{10}{32}$ or 31.25 or 31.3 seen
	Alternative method 2		
	$\frac{42}{32}$ or 1.3125	M1	oe
	$\frac{42}{32} \times 100 (-100)$ or 131.25 (-100) or their 1.3125 $\times 100 (-100)$ or (their 1.3125 – 1) ($\times 100$)	M1dep	oe
	31.25 or 31.3	A1	accept 31 following $\frac{42}{32}$ or 31.25 or 31.3 seen
	Additional Guidance		
	Build up methods must be complete eg 10% = 3.2 30% = 9.6 1% = 0.32 31% = 9.92 Answer 31%		M0

Q	Answer	Mark	Comments
22(b)	Alternative method 1		
	(Silver =) $x - 8$	M1	x is the number of gold medals any letter
	$x + x + x - 8 = 70$	M1dep	oe
	26	A1	
	Alternative method 2		
	(Gold or bronze =) $y + 8$	M1	y is the number of silver medals any letter
	$y + 8 + y + y + 8 = 70$ or $y = 18$	M1dep	oe
	26	A1	
	Alternative method 3		
	$70 + 8$ or 78 or $70 - 16$ or 54	M1	
	their $78 \div 3$ or their $54 \div 3$ or 18	M1dep	
	26	A1	
	Additional Guidance		
	26 26 18 on answer line		M1M1A0
	18 on answer line		M1M1A0
	Trial and improvement is 3 (if correct) or 0		

Q	Answer	Mark	Comments
23	2	B1	

Q	Answer	Mark	Comments
24	5.000 06	B1	

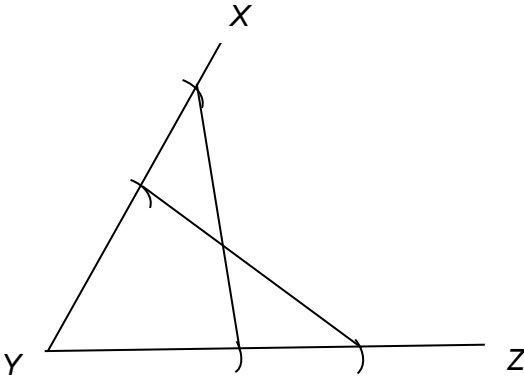
Q	Answer	Mark	Comments
25	$\frac{nx}{4}$	B1	

Q	Answer	Mark	Comments
26		B1	

Q	Answer	Mark	Comments
27	$5xy(x - 7y)$ or $-5xy(7y - x)$	B2	B1 $xy(5x - 35y)$ or $5x(xy - 7y^2)$ or $5y(x^2 - 7xy)$ or $5(x^2y - 7xy^2)$ or $x(5xy - 35y^2)$ or $y(5x^2 - 35xy)$ or fully factorised expression with one error in the bracket
	Additional Guidance		
	Condone multiplication signs for B2 and B1		
	eg1 $5xy \times (x - 7y)$		B2
	eg2 $x \times y \times (5x - 35y)$		B1
	Further work following a B2 answer		B1
	Further work following a B1 answer		B1
	$5xy(x + 7y)$ fully factorised with one error in the bracket		B1
	$5xy(x - 6y)$ fully factorised with one error in the bracket		B1
	Condone missing final bracket		
	eg1 $5xy(x - 7y$		B2
	eg2 $5x(xy - 7y^2$		B1
	Allow equivalent factorised expressions		
	eg $-5x(7y^2 - xy)$		B1
	$xy(5x + 35y)$ one error in the bracket but not fully factorised		B0

Q	Answer	Mark	Comments
28	Alternative method 1		
	A pair of arcs, centre Y, equal radius (± 2 mm), intersecting YX and YZ or a single arc, centre Y, intersecting YX and YZ	M1	oe eg a single arc, centre Y, radius YX intersecting YZ
	Two intersecting arcs, equal radius (± 2 mm), with centres at the intersections on YX and YZ	M1dep	if a single arc, centre Y, radius YX intersecting YZ has been drawn the centres will be at X and the intersection on YZ
	Fully correct method of construction of angle bisector and P marked 6 cm from Y in a position where YP bisects the angle XYZ	A1	± 2 mm
	Alternative method 2		
	A pair of arcs, centre Y, equal radius (± 2 mm), intersecting YX and YZ or a single arc, centre Y, intersecting YX and YZ	M1	oe eg a single arc, centre Y, radius YX intersecting YZ
	Two further arcs, centre Y, equal radius (± 2 mm), intersecting YX and YZ or a further single arc, centre Y, intersecting YX and YZ and two lines from the YX intersection of one arc to the YZ intersection of the other arc	M1dep	if a single arc, centre Y, radius YX, intersecting YZ has been drawn, one line will join X to the intersection on YZ
	Fully correct method of construction of angle bisector and P marked 6 cm from Y in a position where YP bisects the angle XYZ	A1	± 2 mm

Additional guidance is on the next page

28 cont.	Additional Guidance	
	The angle bisector need not be drawn	
	Ignore incorrect arc(s)	
	Condone P not labelled if clearly indicated eg by a cross or dot	
	If P is not labelled or clearly indicated by a cross or dot, take the end of the angle bisector as the position of P	
	The angle bisector need not pass through the intersection of the second pair of arcs but must do so if it were extended	
	Accept an arc touching YX and/or YZ	
	No arc, centre Y , seen on YZ	M0
	Method for alt 2 	M2

Q	Answer	Mark	Comments												
29(a)	<table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr><tr><td>y</td><td>-6</td><td>1</td><td>2</td><td>3</td><td>10</td></tr></table>	x	-2	-1	0	1	2	y	-6	1	2	3	10	B2	B1 one value in the correct position
	x	-2	-1	0	1	2									
	y	-6	1	2	3	10									
Additional Guidance															
	If table contains blanks, values may be implied from the graph or points plotted in part (b)														

Q	Answer	Mark	Comments
29(b)	4 or 5 points plotted correctly	M1	correct or ft their table in (a) $\pm \frac{1}{2}$ small square points may be implied by curve passing through them
	Fully correct smooth cubic curve	A1	$\pm \frac{1}{2}$ small square for each point
	Additional Guidance		
	Correct graph drawn		M1A1
	If two points are plotted for an x -value, then this is choice for that x -value unless their graph passes through one of the points eg $(-2, -6)$ and $(-2, 6)$ plotted is choice unless their graph passes through one of the points		
	Curve must have a decreasing positive gradient to the left of $(0, 2)$ and an increasing positive gradient to the right of $(0, 2)$		
	Condone a positive gradient at $(0, 2)$		
	Condone an infinite gradient at $(-2, -6)$ and/or $(2, 10)$		
	Ignore the curve extended beyond their plots for $(-2, -6)$ and $(2, 10)$		

Q	Answer	Mark	Comments
30	Alternative method 1		
	6^2 and 4.5^2 or 36 and 20.25 or 56.25	M1	oe
	$\sqrt{6^2 + 4.5^2}$ or $\sqrt{36 + 20.25}$ or $\sqrt{56.25}$ or 7.5	M1dep	oe $\frac{4.5}{3} \times 5$ or $\frac{6}{4} \times 5$ oe is M2
	$11 + 4.5 + \text{their } 7.5 + x = 30$ or $30 - 11 - 4.5 - \text{their } 7.5$	M1dep	oe any letter
	7	A1	
	Alternative method 2		
	$(\text{Angle } BDC =) \tan^{-1} \frac{4.5}{6}$ or [36.86, 37] or $(\text{angle } BCD =) \tan^{-1} \frac{6}{4.5}$ or [53, 53.14]	M1	
	$\frac{4.5}{\sin(\text{their } [36.86, 37])}$ or $\frac{6}{\sin(\text{their } [53, 53.14])}$ or [7.477, 7.513]	M1dep	oe eg $\frac{6}{\cos(\text{their } [36.86, 37])}$ $\frac{4.5}{\cos(\text{their } [53, 53.14])}$
	$11 + 4.5 + \text{their } [7.477, 7.513] + x = 30$ or $30 - 11 - 4.5 - \text{their } [7.477, 7.513]$	M1dep	oe any letter
	7	A1	

Additional Guidance for question 30 is on the next page

30 cont.	Additional Guidance	
	The first two method marks may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts	
	$x^2 = 6^2 + 4.5^2 - 2 \times 6 \times 4.5 \times \cos 90$	M1
	Angle $BDC = 36.9$ and $x^2 = 11^2 + 6^2 - 2 \times 11 \times 6 \times \cos 36.9$	M1M0
	Decimal answer rounded to 7	M1M1M1A0

Q	Answer	Mark	Comments
31	Alternative method 1		
	$9p^2 + 45p$	M1	
	$6p^2 + 24p$ or $-6p^2 - 24p$	M1	
	$c = 3$ and $d = 28$	A1ft	ft M1M0 or M0M1 with at most 1 error
	Alternative method 2		
	$9p^2 - 6p^2 = cp^2$ or $3p^2 = cp^2$ or $9 - 6 = c$	M1	equating p^2 terms or coefficients implied by $c = 3$
	$45p - 24p + 7p = dp$ or $28p = dp$ or $45 - 24 + 7 = d$	M1	equating p terms or coefficients implied by $d = 28$
	$c = 3$ and $d = 28$	A1ft	ft M1M0 or M0M1 with at most 1 error
	Additional Guidance		
	Allow recovery of missing brackets, eg $9p^2 + 45p - 6p^2 + 24p + 7p = 3p^2 + 28p$ $c = 3$ and $d = 28$		M1M1A1
	$3p^2 + 28p$ in working implies the method marks		M1M1A0
	$c = 3p^2$ and $d = 28p$ implies the method marks		M1M1A0
	$9p^2 + 45p - 6p^2 - 24p = 3p^2 + 21p$ $c = 3$ and $d = 21$		M1M1A0
	$9p^2 + 45p - 6p^2 + 24p + 7p = 3p^2 + 76p$ $c = 3$ and $d = 76$ (one error)		M1M0A1ft
	$9p^2 + 45p - 5p^2 - 24p + 7p = 4p^2 + 28p$ $c = 4$ and $d = 28$ (one error)		M1M0A1ft
	$9p^2 + 35p - (6p^2 + 24p) + 7p = 3p^2 + 18p$ $c = 3$ and $d = 18$ (one error)		M0M1A1ft
	$9p^2 + 45p - 6p^2 + 24p = 3p^2 + 69p$ $c = 3$ and $d = 69$ (two errors)		M1M0A0ft