GCSE
MATHEMATICS
8300/3H

Paper 3 Calculator

Higher tier

Shadow paper based on June 2024 question paper

Mark scheme

Version: 1.0

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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from aqa.org.uk

Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

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. e.g. accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leqslant$ value $< b$
3.14…	Accept answers which begin 3.14 e.g. 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles.

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

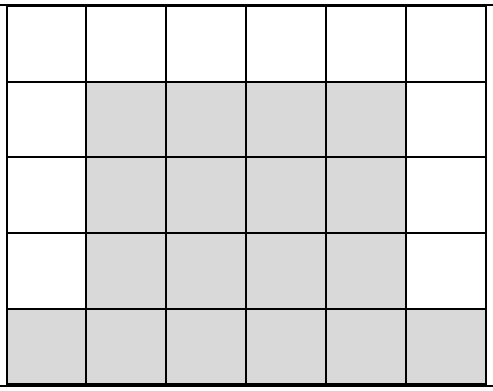
Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

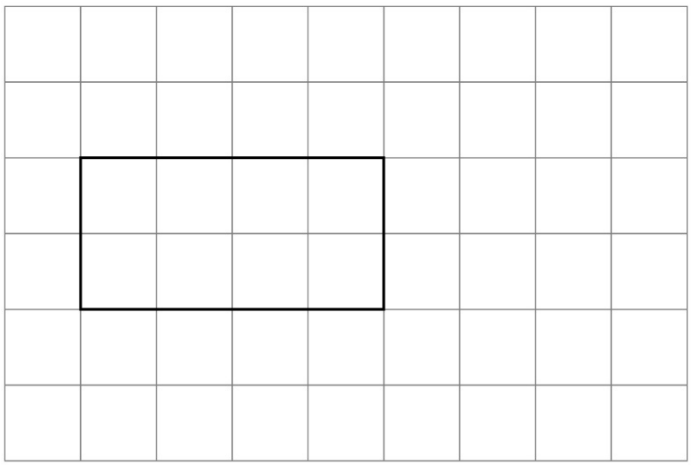
Q	Answer	Mark	Comments
1(a)		B1	
	Additional Guidance		
	Mark intention, condone missing interior lines		
	Shading not required		

Q	Answer	Mark	Comments
1(b)	25	B1	

Q	Answer	Mark	Comments
2	13^2 or 169 **and** 25^2 or 625 or 794	M1	ignore units
	$\sqrt{13^2+25^2}$ or $\sqrt{169+625}$ or $\sqrt{794}$	M1dep	
	28.17(…) or 28.18 or 28.2	A1	accept 28 with 794 seen or M2 awarded
	Additional Guidance		
	M1 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts		
	$25^2 - 13^2$		M1M0A0
	$\sqrt{456}$ without seeing 24^2 or 576 **and** 31^2 or 961		M0M0A0
	Answer only 28.2		M2A1
	Answer only 28		M0
	[28.17, 28.2] … from only accurate drawing		M0M0A0
	[28.17, 28.2] … from only trigonometry		M0M0A0
	[28.17 , 28.2] … from only cosine rule		M1M0A0

Q	Answer	Mark	Comments
3	This is not representative of all people or He didn't take into account other days	B1	oe
	Additional Guidance		
	Ignore incorrect or irrelevant statements or incorrect values alongside a correct reason, unless contradictory		
	Data is biased		B1
	Missing days or missing Wednesday/Thursday/Friday/Saturday/Sunday/weekends.		B1
	There could be different results on the other days.		B1
	Must have a sample from each day		B1
	Only doing 2 out of the 7 days		B1
	Not asked anyone on Wednesday/Thursday/Friday/Saturday/Sunday/weekends.		B1
	Missing most of the other days (ignore 'most of' as irrelevant)		B1
	Sample all days, sample size too small (ignore incorrect statement)		B1
	Needs to sample them all.		B0
	Sample too small		B0
	Some days might be different to others		B0

Q	Answer	Mark	Comments
4	It is true for **one** value of x	B1	

Q	Answer	Mark	Comments
5	24 ÷ (2 × 3) or 4 or rectangle with height 2 cm	M1	oe implied by rectangle with one side 4 cm
	Rectangle with height 2 cm and width 4 cm	A1	any position on the grid
	Additional Guidance		
	Mark intention, condone interior lines		
	Accept unruled lines		
	Side elevation 		M1A1
	Cuboid with rectangle height 2 cm and/or width 7 cm		M1A0

Q	Answer	Mark	Comments
6(a)	**Alternative method 1: working in metres per second or kilometres per second**		
	5250 (metres) or 0.2 (km)	B1	implied by 26.25 or 1312.5
	their 5250 ÷ 200 × 50 or 5.25 ÷ their 0.2 × 50 or 1312.5	M2	oe M1 their 5250 ÷ 200 or 26.25 oe or 200 ÷ 50 or 4 oe or 5.25 ÷ their 0.2 oe
	their 1312.5 ÷ 60	M1dep	oe dep on M2
	21.875 minutes	A1ft	ft their 5250 or their 0.2 Accept 22 minutes with 21.875 seen
	Alternative method 2: working in metres per minute or kilometres per minute		
	5250 (metres) or 0.2 (km)	B1	implied by 0.24
	50 ÷ 60 or $\frac{5}{6}$	M1	oe accept [0.83333 …., 0.84]
	200 ÷ (50 ÷ 60) or 600 or their $\frac{0.2}{(50\div60)}$ or 0.24 or their 5250 × (50 ÷ 60)	M1dep	oe calculation
	their 5250 ÷ their 600 or 5.25 ÷ their 0.24 or their 5250 × (50 ÷ 60) ÷ 200	M1dep	oe
	21.875	A1ft	ft their 5250 or their 0.2 Accept 22 minutes with 21.875

Additional Guidance is on the next page

6(a) cont.	**Additional Guidance**	
	$5250 \div \frac{5}{6}$	B1M2
	$5.25 \div 200 \times 50$	B0M2
	$5.25 \div 0.2 \times 50$	B0M2

Q	Answer	Mark	Comments
6(b)	It is less than the answer to part (a)	B1	

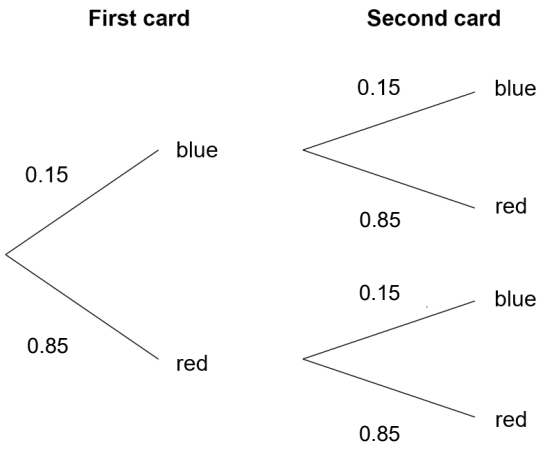
Q	Answer	Mark	Comments
7	Any two of $(-2, 4)$ $(-1, 3.5)$ $(0, 3)$ $(1, 2.5)$ $(2, 2)$ $(3, 1.5)$ $(4, 1)$ or other correct points	M1	may be seen in a table with values assigned to x and y implied by points plotted
	At least two of their points plotted	M1	$\pm\frac{1}{2}$ square implied by a line passing through two of their points
	Single straight line from $(-2, 4)$ to $(4, 1)$	A1	$\pm\frac{1}{2}$ square ignore line beyond $(-2, 4)$ and $(4, 1)$
	Additional Guidance		
	Ignore extra points listed or plotted if required line is drawn		
	M marks can be awarded even if incorrect line drawn		
	Correct line from $(-2, 4)$ to $(4, 1)$ within tolerance with no points plotted		M1M1A1

Q	Answer	Mark	Comments
8	(7 + 5 + 7 + 6 + 6 + 8) ÷ 6 or 39 ÷ 6 or 6.5	M1	Oe Implied by 26
	54 ÷ 360 × 100 or 15	M1	oe
	4 × their 6.5 + their 15 or 26 + 15	M1dep	oe dep on M2
	41	A1	SC2 21.5 or 80
	Additional Guidance		
	Check table and pie chart for working		
	34 + 15%		M1M1M1

Q	Answer	Mark	Comments
9	**Alternative method 1: population density of Town A**		
	95000 ÷ (9 × 2.6) or [4059, 4060]	M2	oe M1 95 000 ÷ 9 or 10 555.555 … oe or 9 × 2.6 or 23.4 oe
	Town B and [4059, 4060]	A1	
	Alternative method 2: comparing one square mile of population		
	95 000 ÷ 9 or [10555 , 10556]	M1	oe
	4750 × 2.6 or 12 350	M1	oe
	Town B and 10 555 and 12 350	A1	
	Alternative method 3: comparing nine square miles of population		
	4750 × 2.6 × 9 or 111 150	M2	oe M1 4750 × 2.6 or 12 350 oe or 9 × 2.6 or 23.4 oe
	Town B and 111 150	A1	
	Alternative method 4: comparing areas with equal populations		
	9 × 2.6 or 23.4	M1	oe
	95 000 ÷ 4750 or 20	M1	oe
	Town B **and** 20 **and** 23 or 23.4	A1	

Q	Answer	Mark	Comments	
10	**Alternative method 1**			
	$1 - 0.42$ or 0.58	M1	oe	
	their 0.58×250	M1dep	oe implied by $\frac{145}{250}$	
	145	A1		
	Alternative method 2			
	0.42×250 or 105	M1	oe	
	$250 -$ their 105	M1dep	oe implied by $\frac{145}{250}$	
	145	A1		
	Additional Guidance			
	'145 out of 250' on answer line			M1M1A1
	Ignore attempt to simplify $\frac{145}{250}$			M1M1A0
	$\frac{145}{250}$ and 145 both on answer line			M1M1A0
	$\frac{105}{250}$			M1M0A0
	Do not allow a misread of any probability			

Q	Answer	Mark	Comments	
11	-2	B1		
	12π	B1		
	Additional Guidance			
	Do not allow use of a numerical value for π			

Q	Answer	Mark	Comments
12(a)	Fully correct diagram	B2	oe B1 0.85 seen once in correct position
	Additional Guidance		
			

Q	Answer	Mark	Comments
12(b)	0.15×0.15 or 0.0225 or 0.15×0.85 or 0.85×0.15 or 0.1275 oe or 0.85×0.85 or 0.7225	M1	oe ft their tree diagram in (a) if all probabilities are between 0 and 1
	$1 - 0.85 \times 0.85$ or $1 - 0.7225$ or $0.15 \times 0.15 + 2 \times 0.15 \times 0.85$ or $0.0225 + 2 \times 0.1275$ or $0.0225 + 0.255$	M1dep	oe ft their tree diagram in (a) if all probabilities are between 0 and 1
	0.2775 or 0.278	A1ft	oe e.g. $\frac{105}{250}$ or 27.75%
	Additional Guidance		
	Calculations or probabilities for part (b) may be seen on diagram in part (a)		
	If part (a) is incorrect full marks may be scored in part (b)		

Q	Answer	Mark	Comments
13	$(x =)$ -1.6, 0.6	B2	B1 at least one of -1.6 and 0.6 with at most one incorrect value or $(-1.6, 0)$ and $(0.6, 0)$ or $(-1.6, 0.6)$
	Additional Guidance		
	(0.6, -1.6)		B0
	(0, -1.6) and (0, 0.6)		B0

Q	Answer	Mark	Comments
14	**Alternative method**		
	$(a =)$ 50 ÷ 2 × 5 or 125	M1	oe may be on diagram
	$(y =)$ $\frac{360 - 50 - their125}{5} \times 2$ or 37 x 2 or 74	M1dep	oe may be on diagram
	$(b =)$ 50 and $(y =)$ 74 or 50 : 74 and $(b : y =)$ 25 : 37 with M2 awarded	A1	
	Additional Guidance		
	50 : 74		M1M1A0

Q	Answer	Mark	Comments
15(a)	Correct method for finding the difference between the x or y coordinates for line *AC*	M1	may be on diagram e.g. $10 - -15$ or 25 or $4 - -6$ or 10
	Correct method for finding the difference between the x or y coordinates for line *AB* or line *BC*	M1dep	may be on diagram e.g. $25 \div (1 + 4)$ or 5 or $10 \div (1 + 4)$ or 2 or $25 \times \frac{4}{1+4}$ or 20 or $10 \times \frac{4}{1+4}$ or 8
	(-4, 5)	A1	
	Additional Guidance		
	Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts		
	Condone any missing minus signs if absolute values for the differences are correct		
	(–4, …) or (…, 5)		M1M1A0

Q	Answer	Mark	Comments
15(b)	$(m_1=)\ \frac{10--15}{-6-4}$ or $(m_1=)\frac{-15-10}{4--6}$ or $-\frac{5}{2}$	M1	gradient of *AC*
	$-1 \div$ their $-\frac{5}{2}$ or $\frac{2}{5}$	M1	gradient of line perpendicular to *AC* their $-\frac{5}{2}$ must be identified as a gradient $\frac{2}{5}$ implies M1M1
	$-15 =$ their $\frac{2}{5} \times 4 + c$ or $(c$ -16.6 or $y--15 =$ their $\frac{2}{5}\ (x-4)$	M1dep	oe condone any letter for c dep on 2nd M1
	$y = \frac{2}{5}x - 16.6$	A1	oe e.g. $5y = 2x - 83$
	Additional Guidance		
	Check part (a) for working for part (b)		

Q	Answer	Mark	Comments
16	$\frac{1}{6}$ or 0.16(6…) or 0.167 or 0.17	M1	oe theoretical probability
	$\frac{13}{90}$ or 0.14(4…)	M1	oe relative frequency
	No and both values in comparable formats	A1	e.g. $\frac{15}{90}$ and $\frac{13}{90}$ or 0.16(6…) or 0.167 or 0.17 **and** 0.14(4…)

Q	Answer	Mark	Comments
17(a)	10	B3	B2 (4000 =) $2^5 \times 5^3$ or 2 × 5 oe or 32 x 125 or 4000 ÷ 16 ÷ 25 B1 $a = 2$ and $b = 5$ or 2, 2, 2, 2, 2 , 5, 5, 5 seen on a factor tree or 125 or 32
	Additional Guidance		
	For B1, 25 or 8 must be chosen from any lists of powers of 5 or cube numbers		
	2 × 2 × 2 x 2 x 2 × 5 × 5 x 5		B2
	$2^3 \times 5^4$		B0

Q	Answer	Mark	Comments
17(b)	$e = cd$	B1	

Q	Answer	Mark	Comments
18(a)	$\frac{\sin x}{12} = \frac{\sin 40}{15}$ or $\frac{12}{\sin x} = \frac{15}{\sin 40}$	M1	oe equation
	$\sin x = \frac{12\sin 40}{15}$ or $\sin x = 0.5142$ ... or $\sin^{-1}\frac{12\sin 40}{15}$ or $\sin^{-1} 0.5142\ldots$	M1dep	oe equation with $\sin x$ as the subject
	[30.9, 31.0] with correct working seen	A1	
	Additional Guidance		
	0.514… may be seen as 0.5 for M marks		
	Only using $x = 31$ in sine rule		M0
	[30.9, 31.0] with no appropriate working		M0M0A0

Q	Answer	Mark	Comments
18(b)	No and correct reason indicating that 40° is a different angle or No and correct reason indicating that 12 cm is a different side	B1	oe e.g. correct reasons 40 is opposite 12 40 is not opposite 15
	Additional Guidance		
	Ignore irrelevant reasons with a correct reason		
	'Yes' ticked		B0
	'No' ticked and states:		
	(A and B are) not congruent		B1
	The sides are not opposite the same angles		B1
	40 is in a different position compared to the sides		B1
	40 is in a different position		B0
	12 is in a different position compared to the angles		B1
	12 is in a different position		B0
	15 was opposite 40 and is now adjacent		B1
	15 was opposite and is now adjacent		B0
	Sides and angles are in different places		B0
	Sides are in different places		B0
	It is a different size		B0
	It is a different shape		B0
	w is 53(.4…) or use of sine rule (question says 'without further calculation')		B0

Q	Answer	Mark	Comments
19(a)	**Alternative method 1**		
	$5 \times 3 - 4$ or $15 - 4$ or 11	M1	
	9	A1	
	Alternative method 2		
	$5x - 4$ - 2 or $5x - 6$	M1	
	9	A1	

Q	Answer	Mark	Comments
19(b)	$(x-2)^2 = 5x$ - 4 or $x^2 - 4x + 4 = 5x$ - 4	M1	oe equation
	$x^2 - 9x + 8$ $(= 0)$	M1dep	oe their 3-term quadratic equation with terms collected correctly
	$(x-1)(x-8)$ or $x = \frac{9 \pm \sqrt{(-9)^2 - 4(1)(8)}}{2(1)}$ or $x = \frac{9 \pm \sqrt{49}}{2}$	M1	oe correct for their 3-term quadratic
	$x = 1$ and $x = 8$	A1	
	Additional Guidance		
	$(x-2)^2 = 5x$ - 4 $\quad x^2 + 4 = 5x$ - 4 $\quad x^2 - 5x + 8$ $(= 0)$	M1M1	
	$(x-2)^2 = 5x$ - 4 $\quad x^2 + 4 = 5x$ - 4 $\quad x^2 - 5x$ $(= 0)$	M1M0	

Q	Answer	Mark	Comments
20	$P \propto Q$ or $P = kQ$ or $18 = k \times 3$ or $R \propto \frac{1}{Q^2}$ or $R = \frac{c}{Q^2}$ or $5 = \frac{c}{4^2}$	M1	oe
	$k = \frac{18}{3}$ or $k = 6$ or $c = 5 \times 4^2$ or $c = 80$	M1dep	oe implied by $P = 6Q$ implied by $R = \frac{80}{Q^2}$
	$P = 6Q$ and $R = \frac{80}{Q^2}$ or $k = 6$ and $c = 80$	A1	oe
	$Q = \frac{0.3}{their6}$ and $R = \frac{their80}{\left(\frac{0.3}{their6}\right)^2}$ or $R = \frac{their80}{0.05^2}$	M1	ft their equations of the form $P = kQ$ and $R = \frac{c}{Q^2}$ their 80 must not be 6
	32 000	A1ft	ft their equations of the form $P = kQ$ and $R = \frac{c}{Q^2}$ with 3rd M1 scored
	Additional Guidance		
	Allow k and c to be any letters, including using both as k		
	Correctly using constants on the left side of their equations – follow the spirit of the mark scheme		
	32 000 with no errors in working		5 marks
	$P \propto kQ$ or $R \propto \frac{c}{Q^2}$ is M0 unless recovered		

Q	Answer	Mark	Comments
21(a)	$2\times\frac{4}{3}\pi r^3=\pi r^2h$	M1	
	$\frac{8}{3}r=h$ or $8r=3h$	M1dep	oe equation with π and r^2 cancelled
	3 : 8 with M2 awarded	A1	oe ratio e.g. $\frac{3}{8}:1$ or $1:\frac{8}{3}$ accept 2.66 or better for $\frac{8}{3}$
	Additional Guidance		
	Accept $h:r=8:3$ for A mark with M2 awarded		

Q	Answer	Mark	Comments
21(b)	$(\pi)(10r)^2(3h)$ or $10^2\times3$	M1	oe ft their formula for a cylinder from part (a) in the form $k\pi r^2h$ with k as a positive constant
	300	A1	
	Additional Guidance		
	Answer 300 from choosing values for r and h e.g. $\pi\times3^2\times4=36\pi$ and $\pi\times30^2\times12=10800\pi$ and $10800\pi\div36\pi=300$		M1A1
	Answer 300 from rounding a decimal		M0A0

Q	Answer	Mark	Comments
22	5 (×) 4 (×) 3 (×) 2	M1	oe
	120 with no errors in working	A1	SC1 625 (allowing repeated digits)
	Additional Guidance		
	Ignore any listing of possible codes		
	Condone further working after 120 seen and M1 awarded e.g. answer as a probability $\frac{1}{120}$		M1A1
	5, 4, 3, 2		M1A0
	5, 4, 3, 2, 1 or $5 \times 4 \times 3 \times 2 \times 1 = 120$		M0A0

Q	Answer	Mark	Comments
23	2	B1	

Q	Answer	Mark	Comments
24	**Alternative method 1**		
	dx^2 or $2dex$ or de^2	M1	
	$dx^2 + 2dex + de^2 + f$	M1dep	
	$3(x-1)^2 + 5$ or $d = 3,\ e = -1,\ f = 5$	A1	SC2 $3(x-2)^2 + 4$ SC1 $3(x-2)^2 + k \quad k \neq 4$ SC1 $3(x+2)^2 + 4$ SC1 $3(x+2)^2 + k$ SC1 $(x-1)^2 + 7$
	Alternative method 2		
	$3(x^2 \ldots)$ or $d = 3$	M1	
	$3\left(x^2 - 2x + \frac{8}{3}\right)$ or $3(x^2 - 2x) + 8$ or $3(x-1)^2 + k$	M1dep	$k \neq 5$
	$3(x-1)^2 + 5$ or $d = 3,\ e = -1,\ f = 5$	A1	SC2 $3(x-2)^2 + 4$ SC1 $3(x-2)^2 + k \quad k \neq 4$ SC1 $3(x+2)^2 + 4$ SC1 $3(x+2)^2 + k$ SC1 $(x-1)^2 + 7$