GCSE
MATHEMATICS
8300/3H

Higher Tier

Paper 3 Calculator

Shadow paper based on 2020 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.

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. eg 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 eg 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 or B or both	B1	

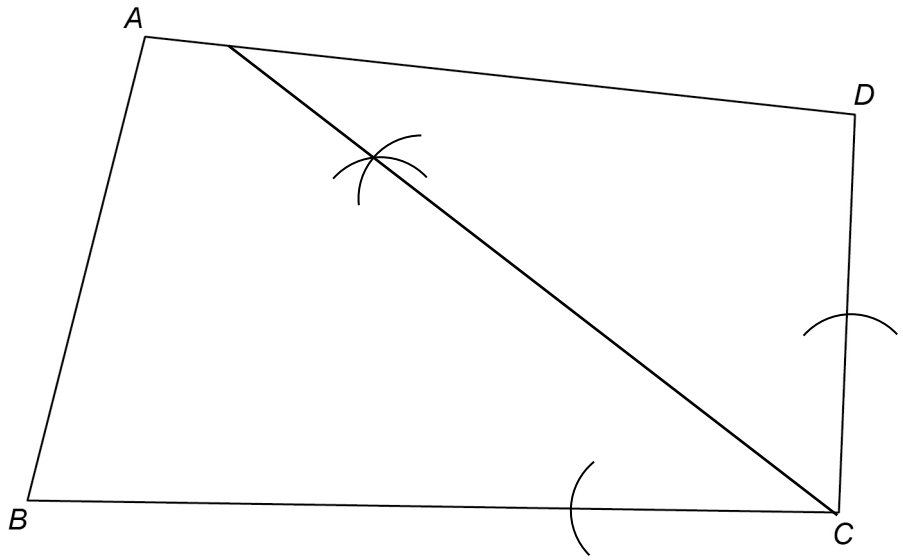
Q	Answer	Mark	Comments
2	$y = -\frac{1}{2}x$	B1	

Q	Answer	Mark	Comments
3	300%	B1	

Q	Answer	Mark	Comments
4	$\frac{1}{8}$	B1	

Q	Answer	Mark	Comments
5(a)	29 499	B1	
	Additional Guidance		
	Accept response in words		
	$29\,499.\dot{9}$ or $29\,49\dot{9}$		B0

Q	Answer	Mark	Comments
5(b)	28 500	B1	
	Additional Guidance		
	Accept response in words		

Q	Answer	Mark	Comments
6	Two arcs of equal radius or a single arc, centre *C*, cutting *BC* and *CD* or a single arc cutting *BC* with radius = *CD*	M1	± 2 mm ± 2 mm
	Fully correct method of construction of bisector of angle *BCD*	A1	
	Additional Guidance		
	Award M1 if correct arc(s) seen alongside incorrect arc(s)		
	Angle bisector does not need to meet *AD* and ignore angle bisector extended beyond *AD*		
	Accept an arc touching the line *BC* or *CD*		
	No arcs seen on *CD*		M0
			

Q	Answer	Mark	Comments
7	28^2 and 45^2 or 784 and 2025 or 2809	M1	
	$\sqrt{28^2 + 45^2}$ or $\sqrt{784 + 2025}$ or $\sqrt{2809}$	M1dep	
	53	A1	
	Additional Guidance		
	Answer only 53		M1M1A1
	53 from scale drawing		M0M0A0
	53 from trigonometry		M0M0A0

Q	Answer	Mark	Comments
8	**Alternative method 1**		
	$30 \times \frac{30}{60}$ or $30 \times \frac{1}{2}$ or 15	M1	oe eg $30 \div 2$
	$135 - 90$ or 45	M1	oe eg $\frac{3}{4}$
	20	A1	
	Alternative method 2		
	$\frac{30}{135-90}$ or $\frac{30}{45}$ or $\frac{2}{3}$ or $\frac{135-90}{30}$ or $\frac{45}{30}$ or $\frac{3}{2}$	M1	oe eg $30 : (135 - 90)$ or $30 : 45$ or $2 : 3$ or $(135 - 90) : 30$ or $45 : 30$ or $3 : 2$
	$30 \times \frac{30}{135-90}$	M1dep	oe eg $\frac{30 \times 30}{45}$ eg $30 \div \frac{3}{2}$
	20	A1	
	Additional Guidance		
	Award M1 or M2 work even if not subsequently used		
	Check diagram for working		
	$30 \div 3 = 10$ and $30 - 10 = 20$		M2A1
	Ignore units unless 15 or 45 is from clearly incorrect working eg 60 (mph) = 60 minutes 30 (mph) = 30 minutes eg 30 (mph) = 30 minutes 15 (mph) = 15 minutes		M1 M0

Q	Answer	Mark	Comments
9	$\frac{20}{25}$ or $\frac{25}{20}$ or $\frac{15}{25}$ or $\frac{25}{15}$ or 15 : 12 or 12 : 15 or 20 : 12 or 12 : 20	M1	oe eg 20 ÷ 25 eg $\frac{4}{5}$ or $\frac{5}{4}$ or $\frac{3}{5}$ or $\frac{5}{3}$ eg 0.8 or 1.25
	12	A1	oe
	Additional Guidance		
	Award M1 work even if not subsequently used		
	15 × 25 ÷ 20		M1

Q	Answer	Mark	Comments
10	$15x - 10$ or $-4x - 3$	M1	may be seen in a grid implied by $-4x - 10 - 3$ or $15x - 13 - 4x$
	$11x - 13$	A1	
	Additional Guidance		
	Do not ignore further working eg $11x - 13 = 19x$ eg $11x - 13$, $c = \frac{13}{11}$		M1A0 M1A0
	$15x - 10 - 4x - 3$		M1

Q	Answer	Mark	Comments
11	**Alternative method 1**		
	1 – 0.28 – 0.56 or 0.16	M1	oe
	their 0.16 × 550	M1dep	oe
	88	A1	
	Alternative method 2		
	0.28 × 550 or 154 or 0.56 × 550 or 308 or 0.84 × 550 or 462	M1	oe
	550 – their 154 – their 308 or 550 – 462	M1dep	oe
	88	A1	
	Additional Guidance		
	$\frac{88}{550}$ on answer line		M1M1A0
	0.84		M0M0A0

Q	Answer	Mark	Comments
12	$a = 0$ and $b = 7$ and $c = 6$ or $a = 1$ and $b = 6$ and $c = 6$ or $a = 2$ and $b = 5$ and $c = 6$ or $a = 3$ and $b = 4$ and $c = 6$ or $a = 4$ and $b = 3$ and $c = 6$ or $a = 5$ and $b = 2$ and $c = 6$ or $a = 6$ and $b = 1$ and $c = 6$	B3	B2 $a + b = 7$ with integer values of $a \geqslant 0$ and $b \geqslant 1$ B1 $c = 6$ or $a + b + c = 13$ with integer values of $a \geqslant 0$ and $b \geqslant 0$ and $c \geqslant 0$ or 15th value = 3 and 16th value = 4 stated or correct median position indicated on a list

Additional Guidance	
Values may be seen alongside or in the table	
Blank answer line does not indicate zero for that value eg $a =$ _____ $b = 7$ $c = 6$	B1
$a = 1$ $b = 5$ $c = 6$	B1
$a = 13$ $b = 0$ $c = 0$	B1
$a = 7$ $b = 0$ $c = 6$	B1
$a = 7$ $b = 0$ $c = 3$	B0

Q	Answer	Mark	Comments
13(a)	$\frac{7a^2}{2}$ or $3\frac{1}{2}a^2$	B2	B1 correct single fraction not in simplest form eg $\frac{168a^2}{48}$ or $3.5a^2$
	Additional Guidance		
	Final answer $3.5a^2$ (even if $\frac{7a^2}{2}$ seen in working)		B1

Q	Answer	Mark	Comments
13(b)	Valid evaluation	B1	eg he needs to divide 15 by 3 or the answer should be $4d - 5$
	Additional Guidance		
	Do not award marks when an incorrect statement or incorrect algebra is seen with a correct statement or correct algebra		
	She needs to subtract 5 not 15		B1
	She must divide all of the numerator by 3		B1
	She must divide everything by 3		B1
	She should divide both sides by 3		B0
	She needs to work out $12d - 15$ then divide by 3		B0
	Her method is wrong		B0
	$4d - 5$ alone		B0

Q	Answer	Mark	Comments
14	80×1.15 or 92 or 60×1.25 or 75	M1	oe
	their $92 \times$ their 75 or 6900	M1dep	oe
	60×80 or 4800	M1	oe
	$\frac{6900 - 4800}{4800} = 43.75\%$ and No	A1	

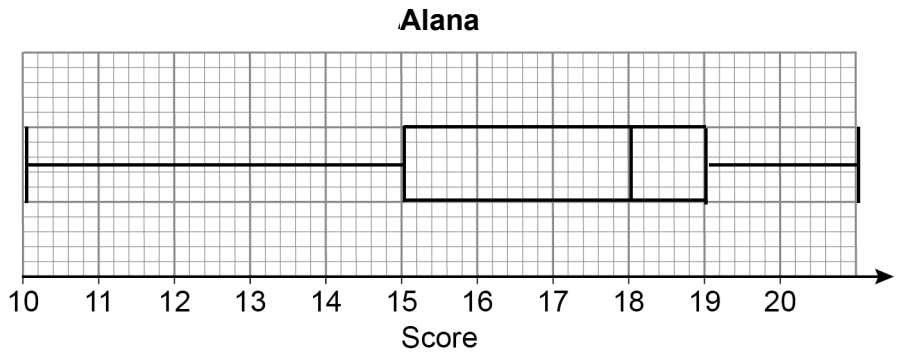
Q	Answer	Mark	Comments
15	**Alternative method 1**		
	$3 + 1 < \frac{x}{5}$ $4 < \frac{x}{5}$ or $-1 - 3 > -\frac{x}{5}$ or $-4 > -\frac{x}{5}$ or $-20 > -x$	M1	oe term in x isolated
	$x > 20$ or $20 < x$	A1	SC1 $x = 20$ or $x < 20$ or $20 > x$
	Alternative method 2		
	$15 < x - 5$ or $x > 5 + 15$ or $-15 > 5 - x$	M1	oe fractions eliminated eg $-5 - 15 > -x$
	$x > 20$ or $20 < x$	A1	SC1 $x = 20$ or $x < 20$ or $20 > x$
	Additional Guidance		
	Do not allow use of '=' for M1 unless recovered for final answer		
	$15 > 1 - x$		M0A0
	20 on answer line with no working		M0A0

Q	Answer	Mark	Comments
16	12 × 8 or 96 and 17 × 11 or 187 and 22 × 4 or 88 and 27 × 2 or 54 or 425	M1	may be seen in table at least two correct products or their values
	$\frac{96+187+88+54}{25}$ or $\frac{425}{25}$ or 425 ÷ 25	M1dep	oe condone bracket error if working seen eg condone 96 + 187 + 88 + 54 ÷ 25
	17	A1	
	Additional Guidance		
	425 ÷ 4		M1M0A0
	Correct product(s) seen in the table but a different method not using their product(s) used for the mean is choice eg 425 in table but mean calculated as 25 ÷ 4 = 6.25		M0M0A0

Q	Answer	Mark	Comments
17	$3(12-2x)$ or $36-6x$ or $12(x+3)$ or $12x+36$ or $12x+6x$ or $18x$ or $6x+2x^2+x(12-2x)$ or $6x+2x^2+12x-2x^2$	M1	oe correct area of small rectangle or large rectangle or unshaded section may be seen on diagram
	$\frac{12(x+3)}{2}=3(12-2x)$ or $12x+6x=3(12-2x)$	M1dep	oe equation eg $6(x+3)=3(12-2x)$ $6x+18=36-6x$ $12(x+3)=6(12-2x)$ $12x+36=72-12x$
	$6x+6x=36-18$ or $12x+6x+6x=36$	M1dep	oe equation with brackets expanded and terms collected eg $12x=18$ $12x+12x=72-36$ $24x=36$
	$\frac{18}{12}$ or $1\frac{1}{2}$ or 1.5	A1	oe
	Additional Guidance		
	$6x+18$		M1
	Trial and improvement with $x=1.5$ chosen		M1M1M1A1
	Trial and improvement without $x=1.5$ chosen		M0M0M0A0

Q	Answer	Mark	Comments
18	**Alternative method 1**		
	65 × 0.45 or 29.25	M1	
	their 29.25 ÷ 2.54^2	M1dep	oe eg $\frac{65 \times 0.45}{2.54^2}$
	4.5(3…)	A1	SC1 11.5(1…) or 11.52
	Alternative method 2		
	65 ÷ 2.54^2 or 10.07(5…)	M1	oe
	their 10.07(5…) × 0.45	M1dep	oe eg $\frac{65}{2.54^2} \times 0.45$
	4.5(3…)	A1	
	Alternative method 3		
	0.45 ÷ 2.54^2 or 0.0697(5…) or 0.0698	M1	oe
	their 0.0697(5…) × 65	M1dep	oe eg $\frac{0.45}{2.54^2} \times 65$
	4.53(3…) or 4.533 or 4.5	A1	
	Additional Guidance		
	SC1 when 2.54 is used and not 2.54^2		

Q	Answer	Mark	Comments
19	$x < 2$ and $y > -3$	B1	

Q	Answer	Mark	Comments
20(a)	Fully correct box plot	B2	B1 three correctly positioned measures
	Additional Guidance		
			B2
	Does not need to be ruled, mark intention ± ½ square		
	Whiskers must stop at 10 and 21 for B2		
	Whiskers must reach 10 and 21 for B2		

Q	Answer	Mark	Comments
20(b)	(Zak IQR =) 3 and (Alana IQR =) 4 and Zak	B2	B1 (Zak IQR =) 3 or (Alana IQR =) 4 or Zak and his box is smaller or Zak and his IQR is smaller
	Additional Guidance		
	Zak's IQR is 1 smaller than Alana's		B2
	Statement based only on incorrect IQR values		B0
	Zak		B0
	Only using range		B0

Q	Answer	Mark	Comments
21(a)	Angle $ABP = 77$ or $180 - 2 \times 77$ or $180 - 154$ or $(180 - 90 - 77) \times 2$	M1	oe may be marked on diagram in correct position
	26	A1	
	Additional Guidance		
	77 or 26 in working with either angle correctly identified, 180 on answer line		M1A0
	77 or 26 in working with neither angle correctly identified, 180 on answer line		M0A0

Q	Answer	Mark	Comments
21(b)	**Alternative method 1**		
	(Angle $CXD =$) $360 - 204$ or 156	M1	may be marked on diagram in correct position
	$156 \div 2 \neq 72$ and No or $72 \times 2 = 144$ and No	A1	
	Alternative method 2		
	(Angle $CXD =$) $72 \times 2 = 144$	M1	may be marked on diagram in correct position
	$204 + 144 \neq 360$ and No or $360 - 144 \neq 204$ and No	A1	
	Additional Guidance		
	Angle *CXD* should be double angle *CED*		M0A0

Q	Answer	Mark	Comments
22	$\frac{220}{400}$ or 0.55 or $\frac{180}{400}$ or 0.45 or $\frac{17}{36}$ or 0.47222… or $\frac{19}{36}$ or 0.52777…	M1	oe
	$\frac{220}{400} \times \frac{17}{36}$ or $\frac{187}{720}$ or 0.26 or 0.2597(2…)	M1	oe implies 1st and 2nd M1
	$\frac{180}{400} \times \frac{19}{36}$ or $\frac{171}{720}$ or 0.2375	M1	oe implies 1st and 3rd M1
	0.26 and 0.2375 and No	A1	must be comparable if fractions used eg $\frac{187}{720}$ and $\frac{171}{720}$ and No
	Additional Guidance		
	Accept values given as percentages		
	Accept decimal values truncated or rounded to 2 dp or better		

Q	Answer	Mark	Comments
23	$(\vec{JN} =) \frac{4}{3} \times 3\mathbf{b}$ or $\mathbf{4b}$	M1	oe eg $(\vec{NJ} =) -4\mathbf{b}$ implied by $\vec{JL} = 7\mathbf{b}$ may be seen on diagram
	$(\vec{JK} =)$ their $4\mathbf{b} + 3\mathbf{b} - 8\mathbf{a}$ or $7\mathbf{b} - 8\mathbf{a}$	M1dep	oe eg $(\vec{KJ} =) 8\mathbf{a} - 7\mathbf{b}$
	$\frac{7}{2}\mathbf{b} - 4\mathbf{a}$ or $3.5\mathbf{b} - 4\mathbf{a}$	A1	oe eg $\frac{1}{2}(7\mathbf{b} - 8\mathbf{a})$ SC2 $3.5\mathbf{a} - 4\mathbf{b}$ or $\frac{7}{2}\mathbf{a} - 4\mathbf{b}$

Q	Answer	Mark	Comments
24(a)	Draws a tangent at (2, 7)	M1	Must see a tangent on the graph
	Their gradient at (2, 7)	A1ft	ft their tangent ± 0.2 tolerance on their readings
	Additional Guidance		
	Mark intention for drawing of tangent		
	No tangent drawn		M0A0

Q	Answer	Mark	Comments
24(b)	It is negative	B1	

Q	Answer	Mark	Comments
25	10	B1	

Q	Answer	Mark	Comments
26	$10x = 41.4\ldots$ or $100x = 414.4\ldots$	M1	oe multiplication by a power of 10 eg $1000x = 4144.4\ldots$ any letter
	$10x - x = 41.4\ldots - 4.14\ldots$ or $9x = 37.3$ with $10x = 41.4\ldots$seen or $100x - 10x = 414.4\ldots - 41.4\ldots$ or $90x = 373$ with $100x = 414.4\ldots$ and $10x = 41.4\ldots$ seen or $100x - x = 414.4\ldots - 4.14\ldots$ or $99x = 410.3$ with $100x = 414.4\ldots$ seen	M1dep	oe subtraction to eliminate recurring digits eg $1000x - 10x = 4144.4\ldots - 41.4\ldots$ or $990x = 4103$ with $1000x = 4144.4\ldots$ and $10x = 41.4\ldots$ seen numbers must all be correct
	$x = 4.14\ldots$ stated and M2 scored and $9x = 37.3$ and $(x =) \frac{37.3}{9}$ and $\frac{373}{90}$ or $x = 4.14\ldots$ stated and M2 scored and $90x = 373$ and $(x =) \frac{373}{90}$ or $x = 4.14\ldots$ stated and M2 scored and $99x = 410.3$ and $(x =) \frac{410.3}{99}$ and $\frac{373}{90}$	A1	oe eg $x = 4.14\ldots$ stated and M2 scored and $990x = 4103$ and $(x =) \frac{4103}{990}$ and $\frac{373}{90}$
	Additional Guidance		
	$373 \div 90 = 4.14\ldots$		M0M0A0

Q	Answer	Mark	Comments
27	(–1, –4)	B1	

Q	Answer	Mark	Comments
28	$-\frac{1}{5}$ or $-1 \div 5$	M1	oe
	$4 =$ their $-\frac{1}{5} \times 10 + c$ or $c = 6$ or $y - 6 = -\frac{1}{5}(x - 10)$	M1dep	oe $y = -\frac{1}{5}x + 6$ implies M2
	$-\frac{1}{5}x + 6 = 0$ or $(x =)$ 30	M1dep	oe
	(30, 0)	A1	SC2 (–10, 0) or (9.2, 0)
	Additional Guidance		
	Answer (0, 30) is A0 but may score M marks if working seen		
	(–10, 0) from using the gradient of the perpendicular as $\frac{1}{5}$		SC2
	(9.2, 0) from using the gradient of the perpendicular as 5		SC2

Q	Answer	Mark	Comments
29	$0.5 \times 10 \times 12 \times \sin 116$ or [53.9, 53.93]	M1	oe
	$10^2 + 12^2 - 2 \times 10 \times 12 \times \cos 116$ or [349.2, 349.21]	M1	oe eg $244 - 240 \times \cos 116$
	$\sqrt{10^2 + 12^2 - 2 \times 10 \times 12 \times \cos 116}$ or [18.686, 18.7] or [9.343, 9.35]	M1dep	oe dep on 2nd M1
	$0.5 \times \pi \times (0.5 \times$ their [18.686, 18.7]$)^2$ or $0.5 \times \pi \times$ their [9.343, 9.35]^2 or [137.1, 137.323]	M1dep	dep on 2nd and 3rd M1
	[191, 191.253]	A1	
	Additional Guidance		
	Diameter must come from using the cosine rule		
	2nd mark is not dependent on the first		

Q	Answer	Mark	Comments
30	$4x$	M1	oe
	$\frac{1}{4}x - 2\left(\frac{1}{4}x\right)^2$ or $\frac{1}{4}x - \frac{2}{16}x^2$	M1	oe $\frac{2}{16}x^2 + \frac{62}{16}x = 0$ oe equation implies M2
	$4x = x\left(\frac{1}{4} - \frac{x}{8}\right)$ $x^2 + 30x = 0$ or $x(x + 30) = 0$	M1dep	dep on M2 oe method for correct quadratic equation
	$x = 0$ and $x = -30$	A1	
	Additional Guidance		
	$\frac{1}{4}x - \frac{2}{16}x^2 = 4x$		M2
	$x^2 + 30x = 0$		M2