

GCSE

Applications of Mathematics (Pilot)

Unit **A382/02**: Higher Tier

General Certificate of Secondary Education

Mark Scheme for June 2015

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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Annotations used in the detailed Mark Scheme.

Annotation	Meaning
✓	Correct
✗	Incorrect
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working (after correct answer obtained), provided method has been completed
M0	Method mark awarded 0
M1	Method mark awarded 1
M2	Method mark awarded 2
A1	Accuracy mark awarded 1
B1	Independent mark awarded 1
B2	Independent mark awarded 2
MR	Misread
SC	Special case
^	Omission sign

These should be used whenever appropriate during your marking.

The **M**, **A**, **B**, etc annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks.

It is vital that you annotate these scripts to show how the marks have been awarded.

It is not mandatory to use annotations for any other marking, though you may wish to use them in some circumstances.

Subject-Specific Marking Instructions

M marks are for using a correct method and are not lost for purely numerical errors.

A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.

B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.

SC marks are for special cases that are worthy of some credit.

Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.

Do not award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen and the correct answer clearly follows from it.

Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, eg FT $180 \times (\textit{their} '37' + 16)$, or FT $300 - \sqrt{(\textit{their} '5^2 + 7^2')}$. Answers to part questions which are being followed through are indicated by eg FT $3 \times \textit{their}$ (a).

For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.

The following abbreviations are commonly found in GCSE Mathematics mark schemes.

- **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point eg 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
- **isw** means **ignore subsequent working** (after correct answer obtained).
- **nfw** means **not from wrong working**.
- **oe** means **or equivalent**.
- **rot** means **rounded or truncated**.
- **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line, even if it is not in the method leading to the final answer.
- **soi** means **seen or implied**.

Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.

As a general principle, if two or more methods are offered, mark only the method that leads to the answer on the answer line. If two (or more) answers are offered, mark the poorer (poorest).

When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the MR annotation. **M** marks are not deducted for misreads.

Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.

If the correct answer is seen in the body and the answer given in the answer space is a clear transcription error allow full marks unless the mark scheme says 'mark final answer' or 'cao'. Place the annotation ✓ next to the correct answer.

If the answer space is blank but the correct answer is seen in the body allow full marks. Place the annotation ✓ next to the correct answer.

Ranges of answers given in the mark scheme are always inclusive.

For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.

Anything in the mark scheme which is in square brackets [...] is not required for the mark to be earned, but if present it must be correct.

Question			Answer/Indicative Content	Marks	Guidance	
					Content	Levels of response
1	a	i	Statement indicating wrist measurement = 2 x thumb measurement oe Allow ratio eg thumb measurement : wrist measurement = 1:2 or t : w = 1 : 2 where t & w qualified as measurements	1		For measurement allow diameter, radius, circumference, size, thickness, girth etc See list in appendix Award 0 if different measures, if only one person implied,
		ii	Sample size ≥ 30 Thumb (measurement) Wrist (measurement) Same units of length specified for each	1 1 1 1		Sample size with length unit award 0 If thumb measure x 2 award 0 If thumb [x2] & wrist have different measures eg radius & diameter or no measures– allow 1 mark from middle two marks Sensible units eg award 0 for km or feet etc; condone metres Frequency table can score mark for sample size & for units if given for both thumb & wrist Ignore extra columns for age / gender / etc Ignore values for thumb &/or wrist

		<p>iii Comment about measurement eg use [same] tape measure oe; one person measuring oe; repeat to check oe; always use right thumb oe</p> <p>Comment about bias eg random selection both genders, mix of ages, adults as children still growing etc</p>	<p>1</p> <p>1</p>		<p>Any sensible comments Award both marks if comment about measure & bias eg 'use the same tape measure on a random group' Allow both marks for any two sensible comments about different considerations of the process Ignore extra comments unless contradictory Contradictory comments imply choice</p>
	b	i All points correct $\pm \frac{1}{2}$ small square	2	M1 for at least 2 points correct $\pm \frac{1}{2}$ small square	Ignore extra points
		ii Reasonable straight ruled line by eye through the plotted points	1		At least two points either side of a line with positive gradient
		iii Outside plotted points oe	1		See examples in appendix If more than one reason where at least one correct allow mark provided others not contradictory or incorrect
		iv $n = 4t$ oe	2	M1 for correct worded equation If M0 then SC1 for $t = 4n$ oe	Allow upper or lower case Accept $n = 4 \times t$ oe Condone x for t & y for n eg $y=4x$

	c	i	<p>$\div 25.4$ and then in either order $+ 0.5$ round up to nearest $\frac{1}{2}$ oe</p> <p>Or in this order $+ 12.7 \div 25.4$ round up to nearest $\frac{1}{2}$ oe</p>	3	<p>M2 for any two correct in correct position</p> <p>or M1 for any one correct in correct position or $[n] \div 25.4$ seen in any box</p>	<p><u>If 2 or 3 marks scored then max 1 penalty if:</u> 'n' also included or implied in two or more "correct" boxes penalise 1 mark eg both 'n' $\div 25.4$ & ('n'$\div 25.4$) + 0.5 seen or 'inch' &/or 'mm' included in two or more "correct" boxes penalise 1 mark.</p>
		ii	<p>$17 \frac{1}{2}$ or 17.5</p>	3	<p>M2 for $(4 \times 106) \div 25.4 + \frac{1}{2}$ oe or answer 17</p> <p>or M1 for $(4 \times 106) \div 25.4$ oe or answer 16.6 to 16.7</p> <p>If M0 then SC2 for answer 5 Or SC1 for $106 \div 25.4 + \frac{1}{2}$ or $(106 + 12.7) \div 25.4$</p>	<p>Condone 35/2 oe $((4 \times 106) + 12.7) \div 25.4$</p> <p>$424 \div 25.4$ $4 \times 4.173\dots$ $(4 \times 106) + 12.7$ soi by 436.7</p> <p>4.6 to 4.7</p>
2	a		<p>$1.4[4] \times 10^{17}$</p>	3	<p>M2 for figs 457 x 365 x 24 x 60 x 60 or better</p> <p>or M1 for product of three or more terms from figs 457 365 24 60 60 1000000000</p> <p>If M0 or M1 then also SC1 for final answer 1.32×10^{17} to 1.33×10^{17}</p>	<p>For 365 allow 365.25 or 366 or 52x7 or 364 Award M2 for figs 143.. to 145.. seen</p> <p>3600 to imply two terms 60 x 60 Eg: look for 365[.25] x 24 x 60 x 60 M1 could be implied by 31536000 [31557600] (31449600 if 52 x7) rot to 3 sig figs</p>

	b		Any correct reason eg: the actual number changes constantly or leap years or its an estimate or rounded	1		If more than one reason where at least one correct allow mark provided others not contradictory or incorrect
3	a	i	Curve: positive skew event begins oe marked at or after all arrived	1 1		condone not start / finish at x-axis
		ii	Curve: negative skew event begins oe after some & before all arrived	1 1		condone not start / finish at x-axis
	b	i	Friday 6am	1		Accept 24 hour clock times
		ii	Saturday 6 am – 9 am	1		Accept 24 hour clock times
	c		Tangent drawn on graph at 2am <i>their</i> vertical reading ÷ <i>their</i> horizontal reading provided at least one value correct ± 2 small squares or answer in following ranges 4000 to 13000 100 to 300 1 to 4 Correct units for <i>their</i> answer 4000 to 13000 people / hour (p/h) 100 to 300 people / minute (p/min) 1 to 4 people / second (p/sec)	M1 A1 B1		Allow tangent to be drawn at point from 1:30 – 2:30 Allow if <i>their</i> answer in correct range for <i>their</i> implied units Allow for <i>their</i> people given as figs ie may not be converted to thousands & <i>their</i> time in minutes or decimal hours or incorrect conversion hours to minutes If no tangent then only B mark possible provided numerical answer in correct range
4	a	i	Almonds	1		

		ii	Strawberries	1		
		iii	0.832	2	M1 for figs 16 x figs 52 or figs 832	
	b	i	Any correct reason	1		Inconsistent scale on horizontal axis or no zero oe or bars should not be joined by line
		ii	Decline (in numbers) oe	1		Ignore actual number of decrease if given
	c		2019	4	B1 for 0.915 or 91.5 seen or implied And M1 for any evaluated trial rot to 2 sigs figs or better of 0.915^n integer $n \geq 2$ And M1 for 8 (years) seen or better correct trial of 0.915^n where $n=5-10$	May be done in stages Award both M marks if $0.915^8 = 0.491\dots$ & 8 years is only working $0.915^2 = 0.837\dots$ $0.915^3 = 0.766\dots$ $0.915^4 = 0.7009\dots$ $0.915^5 = 0.641\dots$ $0.915^6 = 0.5868\dots$ $0.915^7 = 0.5369\dots$ $0.915^8 = 0.491\dots$ $0.915^9 = 0.449\dots$ $0.915^{10} = 0.411\dots$ Values may be given as %, with or without % sign Award B and M marks if successive subtraction of 8.5% with early rounding at each stage providing working clear
5	a	i	8.2	2	M1 for $34 \div 4$ or 8.5 seen	
		ii	14.3	1		

		iii	207 – 210 Accept 205 if 82 [inches] seen	2	M1 for readings from graph that add up to 20.2 Or readings used to find cm / hand Or $((20 \times 4) + 2) [x 2.54\dots]$ or 82 If M0 then SC1 for readings where 'hand' incorrectly interpreted eg 10.1 hands read at between 10 & 10.1 then x2 Or full cm / hand calculations where hand not given as decimal	eg reading at 10.1 hands x 2 or reading at 10 hands & 10.2 hands eg $150 / (14.75 \text{ or } 14.3) \times (20.2 \text{ or } 20.5)$
	b	i	$9 \times 0.8 (= \frac{1}{2} \times 2 \times \pi \times r)$ $(9 \times 0.8) \div \pi$ or $7.2 \div \pi$ or $2 \times r = 4.58$ 2.29(...) seen (answer 2.3 given)	M1 M1 A1		Look for alternatives eg 0.8×18 or $15 \times 0.8 - 6 \times 0.8$ Allow working in cm then convert back If working with $2 \pi r = 0.8 \times 9$, then $2xr = 4.58$, condone 4.58 rounded to 4.6 & then 2.3 for all marks
		ii	6.63 – 6.65 nfw	5	M4 for $2 \times 3 \times 0.8 \times 0.6 + \frac{1}{2} \times \pi \times \text{their } 2.3^2 - \frac{1}{2} \times \pi \times (\text{their } 2.3 - 0.6)^2$ or M1 for $(2 \times) 3 \times 0.8 \times 0.6$ M1 for $\frac{1}{2} \times \pi \times \text{their } 2.3^2$ M1 for $\frac{1}{2} \times \pi \times (\text{their } 2.3 - 0.6)^2$ M1 for their attempt at area of annulus + area two rectangles If 2 nd & 3 rd marks M0 M0 then SC1 for 16.6 to 16.62 & 9 to 9.1	<i>their</i> 2.3 may be <i>their</i> 2.29... from (i) nb: $\frac{1}{2} \pi (2.3^2 - 1.7^2) = \frac{1}{2} \pi \times 2.4$ 3.7 to 3.8 2.88 or 1.44 8.23 to 8.31 4.48 to 4.54 Their attempt at annulus must be calculation involving π ie areas full circles found

6	a	Two correct circles radii 3cm & 5cm centred on T	2	M1 for one correct or two concentric circles centred on T with incorrect radii	Allow all measures $\pm 2\text{mm}$ Allow 1 mark for freehand circles where intention is clear
	b	i Any pair of points on the circles 'such that angle TJR is right angle' note triangle does not need to be drawn	1		Look for 'tangent by eye' at J May see 2 nd R from part (b) (ii) Condone J & R reversed or omitted
		*ii Fully correct geometrical explanation with reference to one of Pythagoras or TJR right-angle or right-angled triangle or radius / tangent is 90 oe and tangent [at J] meets R circle at [only] two possible positions [for R] Reference to Pythagoras or TJR right-angle or they make a right-angled triangle or [JR] tangent to J[osh] circle; other position may or may not be marked, points may or may not be joined	3 2 – 1	For lower mark other possible, unique, position for R marked; points may or may not be joined Or existing points joined to form approximate right angle triangle with attempt at description Or existing points joined with right-angle shown at correct place	Condone R & J reversed if consistent with their labelling Reference to Pythagoras includes quoting formula or $6^2 + 8^2 = 10^2$ Reference to right angle includes radius / tangent Accept for 2 marks Pythagoras implied by $6^2 + 8^2 = 10^2$ or $3^2 + 4^2 = 5^2$

<p>7</p>	<p>*a</p>	<p>Standard [widescreen cinema] (SWC) & 2.4 or 0.416 & 2.57(...) or 0.388 seen or SWC & [12:5 =] 9 : 3.75 or 8.4 : 3.5 seen or SWC & [9:3.5 =] 12:4.66(...) or 12.857(...) : 5 seen</p> <p>Standard [widescreen cinema] & some mathematical discussion showing comparison of 12:5 & 9:3.5 Or SWC & either 2.4 or 2.57(.) seen oe Or 2.4 & 2.57(...) seen oe with no/incorrect choice of screen Or [12:5 =] 9:3.75 & [9:3.5 =] 12:4.66(...) with no/incorrect choice of screen</p>	<p>3</p> <p>2 – 1</p>	<p>For lower mark at least two aspect ratios given as unitary ratios Or 2.57(...) or 0.388 and one screen aspect ratio given as unitary ratio Or conversion at least one aspect ratio to 9:n or n:3.5</p>	<p>FT for all marks <i>their</i> ratio's compared to Ken if non-unitary comparison ie all 9: n or all eg 18 : n incl: Ken</p> <p>Condone 12 : 5 for SWC provided supported by working Allow rounding or truncating of final ratio & ratio's 1:n or n:1</p> <p>SWC 2.4 : 1 & 1 : 0.416... EWC 1.66... : 1 & 1 : 0.6 CM 1.33... : 1 & 1 : 0.75 HD 1.77... : 1 & 1 : 0.5625 Ken 2.57... : 1 & 1 : 0.388...</p>
	<p>b</p>	<p>i</p> <p>29.3[57...] to 29.4</p>	<p>3</p>	<p>M2 for $\tan^{-1}(9/16)$</p> <p>or</p> <p>M1 for $\tan a = 9/16$</p> <p>If M0 then SC1 for $\tan^{-1} x$ where $x = 5/12$ or $3/5$ or $3/4$ or $16/9$ or final answer 0.512... or 32.6... or 60.6...</p>	<p>Accept 29 provided some method shown</p> <p>FT alternative trig methods; award M2 for full equivalent</p>

		ii	27.89 – 27.9 awrt 28 provided full correct method seen	3	<p>M2 for $16 \times (32 \div \sqrt{16^2 + 9^2})$ M1 for $32 \div \sqrt{16^2 + 9^2}$</p> <p><u>Alt:</u> M2 for $32 \times \cos$ <i>their</i> 29.4 oe</p> <p>or M1 for \cos <i>their</i> 29.4 = w/32</p> <p>If M0 then SC2 for 28 with no working Or SC1 for $32 \times \sin$ <i>their</i> 29.4</p>	<p>$32 \div 18.357\dots$ or $32 \div \sqrt{337}$ or 1.743..</p> <p>NB using 29° gives answer 27.9878...</p> <p>For FT, <u>must</u> see a method to check If <i>their</i> angle 45 max possible SC1</p> <p>32×15.7</p>
	c	i	61.25 Accept 61 or 61.3 provided method shown	4	<p>B1 for all midpoints seen or implied or at least one correct product midpoint x F</p> <p>And M1 for 5 or 6 products <i>their</i> midpoints x F; for <i>their</i> midpoints accept value within class, incl both class bounds do not need to be consistent</p> <p>And M1 for \sum (<i>their</i> midpoints x F) \div (6+15+31+40+22+6)</p>	<p>210 675 1705 2600 1650 510</p> <p>35x6 45x15 55x31 65x40 75x22 85x6</p> <p>180-240 600-750 1550-1860 2400-2800 1540-1760 480-540</p> <p>7350 \div 120 (6750 to 7950 \div 120) Allow one error/omission in <i>their</i> midpoints</p>
		ii	(6) 21 52 92 114 (120)	1		

		<p>iii 4, 5 or 6 plots at $ucb \pm \frac{1}{2}$ small square</p> <p>4, 5 or 6 plots at correct height within correct class (FT <u>their</u> values providing all increasing & non-linear)</p> <p>Increasing graph through '7' plotted points provided increasing & non linear</p>	<p>1</p> <p>1</p> <p>1</p>		<p>Bar chart with no curve can get 2nd mark</p> <p>Condone (30, 0) missing / incorrect Allow points joined by curve or straight lines If both bar chart with CF award marks for CF</p>
		<p>iv 62 or strict FT their increasing non-linear graph</p>	<p>1 FT</p>		<p>Strict FT $\pm \frac{1}{2}$ small square their increasing non linear graph</p>
		<p>v 55 nfw</p> <p>54.6 Allow 54 or 55 from correct method seen</p>	<p>3 FT</p> <p>Alt: 3</p>	<p>M1 for at least one correct reading at 54 or 69</p> <p>And M1 for <i>their</i> 88 – <i>their</i> 33</p> <p>Alt: M2 for 0.6 x 31 [+] 0.9 x 40 oe or M1 for 0.6 x 31 oe or 0.9 x 40 oe</p>	<p>Strict FT $\pm \frac{1}{2}$ small square their increasing non-linear graph</p> <p>Alt: <u>not</u> FT</p> <p>18.6 36</p>
8	a	<p>$\frac{106.9 - 105.6}{105.6} \times 100 = 1.23(\dots)$ or</p> <p>$(\frac{106.9}{105.6} \times 100) - 100 = 1.23(\dots)$ or</p> <p>$(\frac{106.9}{105.6} - 1) \times 100 = 1.23(\dots)$ or</p>	<p>2</p>	<p>M1 for $\frac{106.9 - 105.6}{105.6}$ oe or better</p> <p>$\frac{106.9}{105.6}$ oe or better</p>	<p>Eg $\frac{1.3}{105.6}$ scores M1</p>

	b	1996 amount > 100 is same as % change or $101.8 \div 1.018 = 100$ oe seen	1 1		
	c	116.1(...)	3	M2 for 113.5×1.023 or M1 for 113.5×0.023	May be done in stages
	d	[Greater] increase [from 2005]	1		Any mention of decrease scores 0 marks

Question 1 ai	Decision	justification
The circumference of the wrist is double the circumference of your thumb	1	
$2t = w$ where $t =$ thumb circumference & $w =$ wrist circumference	1	
The thumb is enlarged by scale factor 2 to equal the size of the wrist	BOD	
We predict that measuring twice round the thumb is equal to measuring once round a persons wrist	BOD	
We predict that the measurement of the thumb x 2 is equal to the measurement of a persons wrist	BOD	
The circumference of the thumb is half the wrist	BOD	Wrist measurement implied
The measurement of the wrist is always double the measurement of the thumb	BOD	BOD for 'always'
$2t = w$ $t =$ thumb measurement $w =$ wrist measurement	BOD	
Gullivers wrist circumference is twice his thumb circumference	0	Not for specified person
The circumference of the thumb is half the wrist radius	0	Different measures
The greater the size of your wrist the more measurements around your thumb	0	
$2t = w$ $t =$ thumb $w =$ wrist	0	No measures

The measurement of his wrist is twice the measurement of his thumb	0	not for his implies only a person
The measurement of a wrist is twice the size of a thumb	0	Different measures

Question 1biii	Decision	justification
There were no measurements of 105 or more	1	
There are no measurements taken up to 105 and the line does not reach 105	1	given for the first part of the statement, not the second & this is not contradictory
Not similar to other data	1	
Because no thumbs are close to 105	1	
Because there are no results that reach 105mm	1	
As it will be too far off the other measurements	1	
Because there is no data and line of best fit doesn't cover 105mm	BOD	taken together sufficient for BOD, but each statement on its own would be awarded 0
No-one with a thumb measurement of 105 has been found	BOD	
Because nobody had 105mm	BOD	
Because 105 would be an outlier	BOD	
The thumb measurement for 105 is not on the graph	0	
Anything past 100 would be off my chart	0	
Because it is not on the graph	0	
Because the neck size in proportion is not on the graph	0	does not imply extrapolation
Because you cannot use your line of best fit	0	
Because no thumbs are that big	0	
Because it would not fit the line of best fit. It would be anomalous	0	

Because it is not on the graph therefore we cannot see what it is	0	
Because $105 \times 4 = 420$ which would not fit on the graph	0	
Because it does not fit the data pattern therefore it would be anomalous	0	
Because the neck size ges off the graph past 400mm	0	
Because the neck measurement will be higher than 400	0	
Because 105 is too far away from the line of best fit	0	
Because it does not go past it	0	
Because the measurement would be off the graph	0	
Because the neck would get too big	0	

Question 2b	Decision	justification
It is constantly increasing so no accurate age can be given	1	
Because the age continually changes therefore the value is outdated instantly	1	
Changes every second so will never be completely accurate	1	
No one knows exactly when sun was created	BOD	
The number would be too big	0	
Because you cannot be exactly sure which second it began to exist so it's not an accurate time	BOD	
Time is always moving on	BOD	
Too many decimal points	0	
Once you work it out its inaccurate	1	
Age of the sun is inaccurate	BOD	

Number too long for a calculation	0	
It would be hard to put into an equation	0	
Too many numbers to write down	0	
Could not get a precise number	0	too vague

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