GCSE

# MATHEMATICS

# 8300/3H

Higher Tier Paper 3 Calculator

Mark scheme

June 2020

Version: 1.0 Final

*206g8300/3H/MS*

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.

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**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.<br>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 | |

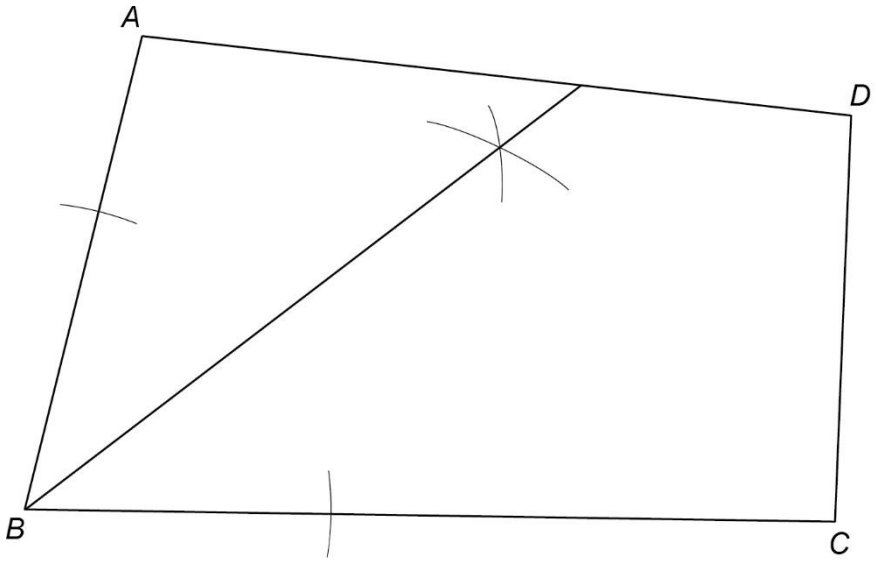
| Q | Answer | Mark | Comments |
|---|---|---|---|
| **2** | $y = \frac{1}{2}x$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **3** | 400% | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **4** | $\frac{1}{16}$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5(a)** | 17 500 | B1 | |
| | **Additional Guidance** | | |
| | Accept response in words | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5(b)** | 18 499 | B1 | |
| | **Additional Guidance** | | |
| | Accept response in words | | |
| | $18\,499.\dot{9}$ or $18\,49\dot{9}$ | | B0 |

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="10">6</td><td>Two arcs of equal radius or a single arc, centre B, cutting BA and BC<br>or<br>a single arc cutting BC with radius = BA</td><td>M1</td><td>± 2 mm<br><br>± 2 mm</td></tr>
<tr><td>Fully correct method of construction of bisector of angle ABC</td><td>A1</td><td></td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">Award M1 if correct arc(s) seen alongside incorrect arc(s)</td><td></td></tr>
<tr><td colspan="2">Angle bisector does not need to meet AD and ignore angle bisector extended beyond AD</td><td></td></tr>
<tr><td colspan="2">Accept an arc touching the line BA or BC</td><td></td></tr>
<tr><td colspan="2">No arcs seen on BC</td><td>M0</td></tr>
<tr><td colspan="3"> 
</td></tr>
</table>

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7 | $32^2$ and $60^2$<br>or<br>1024 and 3600<br>or<br>4624 | M1 | |
| | $\sqrt{32^2+60^2}$ or $\sqrt{1024+3600}$<br>or $\sqrt{4624}$ | M1dep | |
| | 68 | A1 | |
| | **Additional Guidance** | | |
| | Answer only 68 | | M1M1A1 |
| | $68 = 2\sqrt{17}$ incorrect further working | | M1M1A0 |
| | 68 from scale drawing | | M0M0A0 |
| | 68 from trigonometry | | M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8 | **Alternative method 1** | | |
| | $12 \times \frac{30}{60}$<br>or $12 \times \frac{1}{2}$ or 6 | M1 | oe eg $12 \div 2$ |
| | $135 - 90$ or 45 | M1 | oe eg $\frac{3}{4}$ |
| | 8 | A1 | |
| | **Alternative method 2** | | |
| | $\frac{30}{135-90}$ or $\frac{30}{45}$ or $\frac{2}{3}$<br>or<br>$\frac{135-90}{30}$ or $\frac{45}{30}$ or $\frac{3}{2}$ | M1 | oe eg $30 : (135 - 90)$<br>or $30 : 45$<br>or $2 : 3$<br>or $(135 - 90) : 30$<br>or $45 : 30$<br>or $3 : 2$ |
| | $12 \times \frac{30}{135-90}$ | M1dep | oe eg $\frac{12 \times 30}{45}$<br>eg $12 \div \frac{3}{2}$ |
| | 8 | A1 | |
| | **Additional Guidance** | | |
| | Award M1 or M2 work even if not subsequently used | | |
| | Check diagram for working | | |
| | 0.133… implies M1M1 | | |
| | $12 \div 3 = 4$ and $12 - 4 = 8$ | | M2A1 |
| | Answer $-8$ | | M2A0 |
| | Ignore units unless 6 or 45 is from clearly incorrect working<br>eg 12 (mph) = 60 minutes 6 (mph) = 30 minutes<br>eg 12 (mph) = 30 minutes 6 (mph) = 15 minutes | | M1<br>M0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9 | $\frac{16}{20}$ or $\frac{20}{16}$ or $\frac{12}{20}$ or $\frac{20}{12}$<br>or 12 : 9.6 or 9.6 : 12<br>or 16 : 9.6 or 9.6 : 16 | M1 | oe eg 16 ÷ 20<br>eg $\frac{4}{5}$ or $\frac{5}{4}$ or $\frac{3}{5}$ or $\frac{5}{3}$<br>eg 0.8 or 1.25 or 0.6 or 1.66… or 1.67 |
| | 9.6 | A1 | oe |
| | **Additional Guidance** | | |
| | Award M1 work even if not subsequently used | | |
| | Ignore further working in an attempt to round after answer 9.6<br>eg 9.6 in working with answer 10 | | M1A1 |
| | 12 × 20 ÷ 16 | | M1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 10 | $8c + 12$<br>or<br>$-5c + 1$ | M1 | may be seen in a grid<br>implied by $3c + 12 + 1$ or $8c + 13 - 5c$ |
| | $3c + 13$ | A1 | |
| | **Additional Guidance** | | |
| | Do not ignore further working<br>eg $3c + 13 = 16c$<br>eg $3c + 13$, $c = \frac{-13}{3}$ | | M1A0<br>M1A0 |
| | $8c + 12 - 5c - 1$ | | M1 |
| | $8c + 3 - 5c + 1$ | | M1 |

| Q | Answer | Mark | Comments | |
|---|---|---|---|---|
| 11 | **Alternative method 1** | | | |
| | 1 – 0.18 – 0.62 or 0.2 | M1 | oe | |
| | their 0.2 × 350 | M1dep | oe | |
| | 70 | A1 | | |
| | **Alternative method 2** | | | |
| | 0.18 × 350 or 63<br>or<br>0.62 × 350 or 217<br>or<br>0.8 × 350 or 280 | M1 | oe | |
| | 350 – their 63 – their 217<br>or<br>350 – 280 | M1dep | oe | |
| | 70 | A1 | | |
| | **Additional Guidance** | | | |
| | $\frac{70}{350}$ on answer line | | | M1M1A0 |
| | 0.8 | | | M0M0A0 |

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="7">12</td><td>$a = 2$ and $b = 4$ and $c = 5$<br>or<br>$a = 4$ and $b = 2$ and $c = 5$<br>or<br>$a = 0$ and $b = 6$ and $c = 5$</td><td>B3</td><td>B2 $a + b = 6$ with integer values of $a \geqslant 0$ and $b \geqslant 1$<br>B1 $c = 5$<br>or<br>$a + b + c = 11$ with integer values of $a \geqslant 0$ and $b \geqslant 0$ and $c \geqslant 0$<br>or<br>13th value = 3 and 14th value = 4 stated<br>or<br>correct median position indicated on a list</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">Values may be seen alongside or in the table</td><td></td></tr>
<tr><td colspan="2">Blank answer line does not indicate zero for that value<br>eg $a =$ _____ $b = 6$ $c = 5$</td><td>B1</td></tr>
<tr><td colspan="2">$a = 2$ $b = 6$ $c = 5$</td><td>B1</td></tr>
<tr><td colspan="2">$a = 11$ $b = 0$ $c = 0$</td><td>B1</td></tr>
<tr><td colspan="2">$a = 6$ $b = 0$ $c = 5$</td><td>B1</td></tr>
<tr><td colspan="2">$a = 6$ $b = 0$ $c = 3$</td><td>B0</td></tr>
</table>

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13(a) | $\frac{5a^2}{4}$ or $1\frac{1}{4}a^2$ | B2 | B1 correct single fraction not in simplest form<br>eg $\frac{50a^2}{40}$<br>or<br>$1.25a^2$<br>or<br>$\frac{5}{4}a$ or $\frac{5a}{4}$ or $1\frac{1}{4}a$ |
| | **Additional Guidance** | | |
| | Final answer $1.25a^2$ (even if $\frac{5a^2}{4}$ seen in working) | | B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 13(b) | Valid evaluation | B1 | eg she needs to divide 10 by 2<br>or<br>the answer should be $3c + 5$ |
| | **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 add 5 not 10 | | B1 |
| | She must divide all of the numerator by 2 | | B1 |
| | She must divide everything by 2 | | B1 |
| | She should divide both sides by 2 | | B0 |
| | She needs to work out $6c + 10$ then divide by 2 | | B0 |
| | Her method is wrong | | B0 |
| | $3c + 5$ alone | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14 | **Alternative method 1** | | |
| | 60 × (1 – 0.15) or 60 × 0.85 or 51<br>or<br>40 × (1 – 0.1) or 40 × 0.9 or 36 | M1 | oe<br>60 × 0.15 or 9<br>or<br>40 × 0.1 or 4 |
| | 2 × their 51 + 2 × their 36 or 174 | M1dep | oe<br>2 × their 9 + 2 × their 4 or 26<br>their 51, their 36, their 9 and their 4 must come from a correct method |
| | (2 × 60 + 2 × 40) × 0.75<br>or 200 × 0.75 or 150<br>or<br>(2 × 60 + 2 × 40) × 0.25<br>or 200 × 0.25 or 50 | M1 | oe |
| | 174 and 150 and No<br>or<br>224 and 200 and No<br>or<br>26 and 50 and No | A1 | SC3 176 and 150 and No<br>or 226 and 200 and No<br>or 24 and 50 and No |

**Mark scheme and Additional Guidance continue on the next page**

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **14 cont** | **Alternative method 2** | | |
| | $60 \times (1 - 0.15)$ or $60 \times 0.85$ or 51<br>or<br>$40 \times (1 - 0.1)$ or $40 \times 0.9$ or 36 | M1 | oe<br>$60 \times 0.15$ or 9<br>or<br>$40 \times 0.1$ or 4 |
| | $2 \times$ their 51 + $2 \times$ their 36 or 174 | M1dep | oe<br>$2 \times$ their 9 + $2 \times$ their 4 or 26<br>their 51, their 36, their 9 and their 4 must come from a correct method |
| | $\frac{(2\times 60 + 2\times 40) - \text{their } 174}{2\times 60 + 2\times 40} \times 100$<br>or $\frac{200 - \text{their } 174}{200} \times 100$<br>or 13(%)<br>or $\frac{174}{200} \times 100$ and $100 - 25$<br>or 87(%) and 75(%) | M1dep | oe<br>$\frac{2\times \text{their } 9 + 2\times \text{their } 4}{200} \times 100$<br>or $\frac{26}{200} \times 100$ or 13(%)<br>or<br>$\frac{200 - (2\times \text{their } 9 + 2\times \text{their } 4)}{200} \times 100$<br>and 100(%) – 25(%)<br>or 87(%) and 75(%) |
| | 13% and No<br>or 87% and 75% and No | A1 | oe<br>SC3 12% and No<br>or 88% and 75% and No |
| | **Additional Guidance** | | |
| | Ignore incorrect statements or calculations with full mark response | | |
| | Consistently working with half of a perimeter can score up to 4 marks | | |
| | SC3 must come from transposing length and width values | | |
| | Accept length and width values transposed for up to 3 marks<br>eg $60 \times 0.9$ with $40 \times 0.85$ and $2 \times 54 + 2 \times 34$<br>eg $60 \times 0.9$ with $40 \times 0.9$ and $2 \times 54 + 2 \times 36$ (not transposed)<br>eg $60 \times 0.1$ or $40 \times 0.15$ or 6 | | M1M1<br>M1M0<br>M1 |

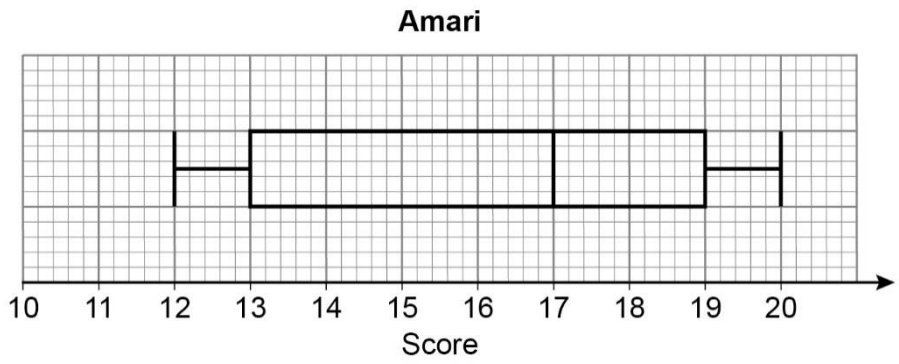
| Q | Answer | Mark | Comments |
|---|---|---|---|
| 15 | **Alternative method 1** | | |
| | $\frac{x}{3} > 11 - 4$<br>or $\frac{x}{3} > 7$<br>or<br>$4 - 11 > -\frac{x}{3}$<br>or $-7 > -\frac{x}{3}$<br>or<br>$-21 > -x$ | M1 | oe term in $x$ isolated |
| | $x > 21$ or $21 < x$ | A1 | SC1 $x = 21$ or $x < 21$ or $21 > x$ |
| | **Alternative method 2** | | |
| | $12 > 33 - x$<br>or<br>$x > 33 - 12$<br>or<br>$-12 < -33 + x$ | M1 | oe fractions eliminated<br>eg $12 - 33 > -x$ |
| | $x > 21$ or $21 < x$ | A1 | SC1 $x = 21$ or $x < 21$ or $21 > x$ |
| | **Additional Guidance** | | |
| | Do not allow use of '=' for M1 unless recovered for final answer | | |
| | $12 > 11 - x$ | | M0A0 |
| | 21 on answer line with no working | | M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **16** | $2 \times 6$ or 12<br>and<br>$7 \times 11$ or 77<br>and<br>$12 \times 3$ or 36<br>or<br>125 | M1 | may be seen in table<br>at least two correct products or their values |
| | $\frac{\text{their } 12 + \text{their } 77 + \text{their } 36}{20}$<br>or $\frac{125}{20}$ or $125 \div 20$ or $6\frac{1}{4}$ | M1dep | oe<br>condone bracket error if working seen<br>eg condone $12 + 77 + 36 \div 20$ |
| | 6.25 | A1 | |
| | **Additional Guidance** | | |
| | 6.25 in working, 6 on answer line | | M1M1A0 |
| | $125 \div 3$ | | M1M0A0 |
| | Correct product(s) seen in the table but a different method not using their product(s) used for the mean is choice<br>eg 125 in table but mean calculated as $20 \div 3 = 6.7$ | | M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17 | $2(12 - x)$ or $24 - 2x$<br>or<br>$12(x + 2)$ or $12x + 24$<br>or<br>$12x + 2x$ or $14x$<br>or<br>$2x + x^2 + x(12 - x)$<br>or $2x + x^2 + 12x - x^2$ | M1 | oe<br>correct area of small rectangle or large rectangle or unshaded section<br>may be seen on diagram |
| | $\frac{12(x+2)}{4} = 2(12 - x)$<br>or<br>$12x + 2x = 6(12 - x)$ | M1dep | oe equation<br>eg $3(x + 2) = 2(12 - x)$<br>$3x + 6 = 24 - 2x$<br>$12(x + 2) = 8(12 - x)$<br>$12x + 24 = 96 - 8x$ |
| | $3x + 2x = 24 - 6$<br>or<br>$14x + 6x = 72$ | M1dep | oe equation with brackets expanded and terms collected<br>eg $5x = 18$<br>$12x + 8x = 96 - 24$<br>$20x = 72$ |
| | $\frac{18}{5}$ or $3\frac{3}{5}$ or 3.6 | A1 | oe |
| | **Additional Guidance** | | |
| | $3x + 6$ | | M1 |
| | Trial and improvement with $x = 3.6$ chosen | | M1M1M1A1 |
| | Trial and improvement without $x = 3.6$ chosen | | M0M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 18 | **Alternative method 1** | | |
| | 30 × 0.45 or 13.5 | M1 | |
| | their 13.5 ÷ $2.54^2$ | M1dep | oe eg $\frac{30 \times 0.45}{2.54^2}$ |
| | 2.09(2…) or 2.093 or 2.1 | A1 | SC1 5.31(4…) or 5.315 or 5.3 |
| | **Alternative method 2** | | |
| | 30 ÷ $2.54^2$ or 4.65(0…) | M1 | oe |
| | their 4.65(0…) × 0.45 | M1dep | oe eg $\frac{30}{2.54^2} \times 0.45$ |
| | 2.09(2…) or 2.093 or 2.1 | A1 | SC1 5.31(4…) or 5.315 or 5.3 |
| | **Alternative method 3** | | |
| | 0.45 ÷ $2.54^2$ or 0.0697(5…) or 0.0698 | M1 | oe |
| | their 0.0697(5…) × 30 | M1dep | oe eg $\frac{0.45}{2.54^2} \times 30$ |
| | 2.09(2…) or 2.093 or 2.1 | A1 | SC1 5.31(4…) or 5.315 or 5.3 |
| | **Additional Guidance** | | |
| | SC1 when 2.54 is used and not $2.54^2$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 19 | $x < 1$ 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 12 and 20 for B2 | | |
| | Whiskers must reach 12 and 20 for B2 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 20(b) | (Ben IQR =) 3<br>and<br>(Amari IQR =) 6<br>and<br>Ben | B2 | B1 (Ben IQR =) 3<br>or<br>(Amari IQR =) 6<br>or<br>Ben and his box is smaller<br>or<br>Ben and his IQR is smaller |
| | **Additional Guidance** | | |
| | Ben's IQR is 3 smaller than Amari's | | B2 |
| | Statement based only on incorrect IQR values | | B0 |
| | Ben | | B0 |
| | Only using range | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 21(a) | Angle *ABP* = 71<br>or<br>180 – 2 × 71<br>or<br>180 – 142<br>or<br>(180 – 90 – 71) × 2 | M1 | oe<br>may be marked on diagram in correct position |
| | 38 | A1 | |
| | **Additional Guidance** | | |
| | 71 or 38 in working with either angle correctly identified, 180 on answer line | | M1A0 |
| | 71 or 38 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 ÷ 2 = 78 and Yes<br>or<br>78 × 2 = 156 and Yes | A1 | |
| | **Alternative method 2** | | |
| | (Angle *CXD* =) 78 × 2 = 156 | M1 | may be marked on diagram in correct position |
| | 204 + 156 = 360 and Yes<br>or<br>360 – 156 = 204 and Yes | A1 | |
| | **Additional Guidance** | | |
| | Angle *CXD* should be double angle *CED* | | M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 22 | $\frac{120}{250}$ or 0.48<br>or<br>$\frac{130}{250}$ or 0.52<br>or<br>$\frac{17}{32}$ or 0.53125<br>or<br>$\frac{15}{32}$ or 0.46875 | M1 | oe |
| | $\frac{120}{250} \times \frac{17}{32}$ or $\frac{51}{200}$ or 0.255 | M1 | oe<br>implies 1st and 2nd M1 |
| | $\frac{130}{250} \times \frac{15}{32}$ or $\frac{39}{160}$ or 0.24375 | M1 | oe<br>implies 1st and 3rd M1 |
| | 0.255 and 0.24375 and Yes | A1 | must be comparable if fractions used<br>eg $\frac{204}{800}$ and $\frac{195}{800}$ and Yes |
| | **Additional Guidance** | | |
| | Accept values given as percentages | | |
| | Accept decimal values truncated or rounded to 2 dp or better | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 23 | $(\overrightarrow{JN} =) \frac{3}{2} \times 4\mathbf{b}$ or $6\mathbf{b}$ | M1 | oe eg $(\overrightarrow{NJ} =) -6\mathbf{b}$<br>implied by $\overrightarrow{JL} = 10\mathbf{b}$<br>may be seen on diagram |
| | $(\overrightarrow{JK} =)$ their $6\mathbf{b} + 4\mathbf{b} - 7\mathbf{a}$<br>or $10\mathbf{b} - 7\mathbf{a}$ | M1dep | oe eg $(\overrightarrow{KJ} =) \ 7\mathbf{a} - 10\mathbf{b}$ |
| | $5\mathbf{b} - \frac{7}{2}\mathbf{a}$ or $5\mathbf{b} - 3.5\mathbf{a}$ | A1 | oe eg $\frac{1}{2}(10\mathbf{b} - 7\mathbf{a})$<br>SC2 $3.5\mathbf{a} - 5\mathbf{b}$ or $\frac{7}{2}\mathbf{a} - 5\mathbf{b}$ |
| | **Additional Guidance** | | |
| | | | |

| 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<br>± 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 | 6 | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26 | **Alternative method 1 Working with 3.47…..** | | |
| | $10x = 34.7…$<br>or $100x = 347.7…$ | M1 | oe multiplication by a power of 10<br>eg $1000x = 3477.7…$<br>any letter |
| | $10x – x = 34.7… – 3.47…$<br>or $9x = 31.3$ with $10x = 34.7…$seen<br>or<br>$100x – 10x = 347.7… – 34.7…$<br>or $90x = 313$ with $100x = 347.7…$<br>and $10x = 34.7…$ seen<br>or<br>$100x – x = 347.7… – 3.47…$<br>or $99x = 344.3$ with<br>$100x = 347.7…$ seen | M1dep | oe subtraction to eliminate recurring digits<br>eg $1000x – 10x = 3477.7… – 34.7…$<br>or $990x = 3443$ with $1000x = 3477.7…$<br>and $10x = 34.7…$ seen<br>numbers must all be correct |
| | $x = 3.47…$ stated and M2 scored<br>and $9x = 31.3$<br>and $(x =) \frac{31.3}{9}$ and $\frac{313}{90}$<br>or<br>$x = 3.47…$ stated and M2 scored<br>and $90x = 313$<br>and $(x =) \frac{313}{90}$<br>or<br>$x = 3.47…$ stated and M2 scored<br>and $99x = 344.3$<br>and $(x =) \frac{344.3}{99}$ and $\frac{313}{90}$ | A1 | oe<br>eg $x = 3.47…$ stated and M2 scored<br>and $990x = 3443$<br>and $(x =) \frac{3443}{990}$ and $\frac{313}{90}$ |

**Mark scheme continues on the next three pages**

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **26 cont** | **Alternative method 2 Working with 0.47…..** | | |
| | $10x = 4.7\ldots$<br>or $100x = 47.7\ldots$ | M1 | oe multiplication by a power of 10<br>eg $1000x = 477.7\ldots$<br>any letter |
| | $10x - x = 4.7\ldots - 0.47\ldots$<br>or $9x = 4.3$ with $10x = 4.7\ldots$ seen<br>or<br>$100x - 10x = 47.7\ldots - 4.7\ldots$<br>or $90x = 43$ with $100x = 47.7\ldots$<br>and $10x = 4.7\ldots$ seen<br>or<br>$100x - x = 47.7\ldots - 0.47\ldots$<br>or $99x = 47.3$<br>with $100x = 47.7\ldots$ seen | M1dep | oe subtraction to eliminate recurring digits<br>eg $1000x - 10x = 477.7\ldots - 4.7\ldots$<br>or $990x = 473$ with $1000x = 477.7\ldots$<br>and $10x = 4.7\ldots$ seen<br>numbers must all be correct |
| | $x = 0.47\ldots$ stated and M2 scored<br>and $9x = 4.3$ and $(x =) \frac{4.3}{9}$<br>and $3\frac{4.3}{9}$ and $\frac{313}{90}$<br>or<br>$x = 0.47\ldots$ stated and M2 scored<br>and $90x = 43$ and $(x =) \frac{43}{90}$<br>and $3\frac{43}{90}$ and $\frac{313}{90}$<br>or<br>$x = 0.47\ldots$ stated and M2 scored<br>and $99x = 47.3$ and $(x =) \frac{47.3}{99}$<br>and $3\frac{47.3}{99}$ and $\frac{313}{90}$ | A1 | oe<br>eg $x = 0.47\ldots$ stated and M2 scored<br>and $990x = 473$ and $(x =) \frac{473}{990}$<br>and $3\frac{473}{990}$ and $\frac{313}{90}$ |

**Mark scheme continues on the next page**

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26 cont | **Alternative method 3 Working with 0.07…..** | | |
| | $10x = 0.7\ldots$<br>or $100x = 7.7\ldots$ | M1 | oe multiplication by a power of 10<br>eg $1000x = 77.7\ldots$<br>any letter |
| | $10x - x = 0.7\ldots - 0.07\ldots$<br>or $9x = 0.7$ with $10x = 0.7\ldots$ seen<br>or<br>$100x - 10x = 7.7\ldots - 0.7\ldots$<br>or $90x = 7$ with $100x = 7.7\ldots$<br>and $10x = 0.7\ldots$ seen<br>or<br>$100x - x = 7.7\ldots - 0.07\ldots$<br>or $99x = 7.7$<br>with $100x = 7.7\ldots$ seen | M1dep | oe subtraction to eliminate recurring digits<br>eg $1000x - 10x = 77.7\ldots - 0.7\ldots$<br>or $990x = 77$ with $1000x = 77.7\ldots$<br>and $10x = 0.7\ldots$ seen<br>numbers must all be correct |
| | $x = 0.07\ldots$ stated and M2 scored<br>and $9x = 0.7$ and $(x =) \frac{0.7}{9}$<br>and $3.4 + \frac{0.7}{9}$ and $\frac{313}{90}$<br>or<br>$x = 0.07\ldots$ stated and M2 scored<br>and $90x = 7$ and $(x =) \frac{7}{90}$<br>and $3.4 + \frac{7}{90}$ and $\frac{313}{90}$<br>or<br>$x = 0.07\ldots$ stated and M2 scored<br>and $99x = 7.7$ and $(x =) \frac{7.7}{99}$<br>and $3.4 + \frac{7.7}{99}$ and $\frac{313}{90}$ | A1 | oe<br>eg $x = 0.07\ldots$ stated and M2 scored<br>and $990x = 77$ and $(x =) \frac{77}{990}$<br>and $3.4 + \frac{77}{990}$ and $\frac{313}{90}$ |

**Additional guidance continues on the next page**

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **26 cont** | **Additional Guidance** | | |
| | 313 ÷ 90 = 3.47… | | M0M0A0 |
| | Alt 1 M1dep<br>oe subtraction to eliminate recurring decimals includes<br>$100x - 10x = 313$ with $100x = 347.7\ldots$ and $10x = 34.7\ldots$ seen<br>or $90x = 347.7\ldots - 34.7\ldots$ with $100x = 347.7\ldots$ and $10x = 34.7\ldots$ seen<br>(apply same principle in Alt 2 and Alt 3) | | |
| | Alt 2 equivalents for final part of A1<br>eg For $3\frac{43}{90}$ and $\frac{313}{90}$<br>allow $3 + \frac{43}{90}$ and $\frac{313}{90}$ | | |
| | Alt 3 equivalents for final part of A1<br>eg For $3.4 + \frac{7}{90}$ and $\frac{313}{90}$<br>allow $3 + \frac{4}{10} + \frac{7}{90}$ and $\frac{313}{90}$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **27** | (1, –6) | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 28 | $-\frac{1}{4}$ or $-1 \div 4$ | M1 | oe |
| | 5 = their $-\frac{1}{4} \times 8 + c$ or $c = 7$<br>or<br>$y - 5 = -\frac{1}{4}(x - 8)$ | M1dep | oe<br>$y = -\frac{1}{4}x + 7$ implies M2 |
| | $-\frac{1}{4}x + 7 = 0$ or $(x =)\ 28$ | M1dep | oe |
| | (28, 0) | A1 | SC2 (–12, 0) or (6.75, 0) |
| | **Additional Guidance** | | |
| | Answer (0, 28) is A0 but may score M marks if working seen | | |
| | (–12, 0) from using the gradient of the perpendicular as ¼ | | SC2 |
| | (6.75, 0) from using the gradient of the perpendicular as 4 | | SC2 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 29 | $0.5 \times 8 \times 10 \times \sin 114$<br>or [36.5, 36.542] | M1 | oe |
| | $8^2 + 10^2 - 2 \times 8 \times 10 \times \cos 114$<br>or [229, 229.1] | M1 | oe eg $164 - 160 \times \cos 114$ |
| | $\sqrt{8^2 + 10^2 - 2 \times 8 \times 10 \times \cos 114}$<br>or [15.1, 15.14]<br>or [7.55, 7.57] | M1dep | oe<br>dep on 2nd M1 |
| | $0.5 \times \pi \times (0.5 \times$ their[15.1, 15.14]$)^2$<br>or<br>$0.5 \times \pi \times$ their [7.55, 7.57]$^2$<br>or [89.49, 90.03] | M1dep | dep on 2nd and 3rd M1 |
| | [125.99, 126.572] | A1 | |
| | **Additional Guidance** | | |
| | Diameter must come from using the cosine rule | | |
| | 2nd mark is not dependent on the first | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 30 | $2x$ | M1 | oe |
| | $\frac{1}{2}x - \left(\frac{1}{2}x\right)^2$ or $\frac{1}{2}x - \frac{1}{4}x^2$ | M1 | oe<br>$\frac{1}{4}x^2 + \frac{3}{2}x = 0$ oe equation implies M2 |
| | $x\left(\frac{1}{4}x + \frac{3}{2}\right) = 0$<br>or<br>$x(x + 6) = 0$ | M1dep | dep on M2<br>oe method for correct quadratic equation<br>eg $\frac{-6 \pm \sqrt{6^2 - 4\times1\times0}}{2\times1}$ |
| | $x = 0$ and $x = -6$ | A1 | |
| | **Additional Guidance** | | |
| | $\frac{1}{2}x - \frac{1}{4}x^2 = 2x$ | | M2 |
| | $2x - x^2 = 8x$ | | M2 |
| | $x^2 + 6x = 0$ | | M2 |