# AQA

# AQA LEVEL 2 CERTIFICATE
# FURTHER MATHEMATICS (8365/2)

Paper 2

## Mark scheme

Specimen 2020

Version 2.0

Principal Examiners have prepared these mark schemes for specimen papers. These mark schemes have not, therefore, been through the normal process of standardising that would take place for live papers.

Further copies of this Mark Scheme are available from aqa.org.uk

# Glossary for Mark Schemes

AQA examinations are marked in such a way as to award positive achievement wherever possible. Thus, for these 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 within the scheme 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><br>eg accept 0.5 as well as $\frac{1}{2}$ |
| **[a, b]** | Accept values between *a* and *b* inclusive. |
| **3.14 …** | Allow 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.

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **1** | $x$-coordinate of $Q = 6 \div 2$ or 3 | M1 | may be implied or seen on diagram |
| | $0.5 \times 6 \times$ their 3 | M1dep | |
| | 9 | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **2** | $x^2 + y^2 = 100$ or $x^2 + y^2 = 10^2$ | B2 | B1 radius = 10 |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **3** | $p = 2.5$ or $\dfrac{5}{2}$ or $2\dfrac{1}{2}$ | B1 | |
| | $r = -5$ | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **4(a)** | $x > 6$ | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **4(b)** | $x \leqslant -4$ or $x \geqslant 4$ | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **5(a)** | (2, 0) | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5(b)** | 6 | B1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **6(a)** | $4s + 5 = -1$ <br> or $-7s - 10 = t$ | M1 | oe equation |
| | $s = -1.5$ | A1 | |
| | $t = 0.5$ | A1ft | ft $-7 \times$ their $s - 10$ |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **6(b)** | 4 | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **7** | (gradient =) 0.5 or $\dfrac{1}{2}$ | M1 | |
| | $0 = $ their $0.5 \times 4 + c$ or $c = -2$ <br> or $y - 0 = $ their $0.5(x - 4)$ | M1 | oe |
| | $y = 0.5x - 2$ <br> or $y = 0.5(x - 4)$ | A1 | oe simplified equation |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| 8(a) | $\dfrac{ab}{cd} \times \dfrac{ad}{bc}$ | M1 | oe |
| | $\dfrac{a^2}{c^2}$ | A1 | |
| | **Additional Guidance** | | |
| | | | |
| 8(b) | Common denominator with at least one numerator correct | M1 | eg $\dfrac{21}{6x^2} + \dfrac{8x}{6x^2}$  or  $\dfrac{21x}{6x^3} + \dfrac{8x^2}{6x^3}$ |
| | $\dfrac{21 + 8x}{6x^2}$ | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| 9 | $x + 62 = 2(2x - 50)$ | M1 | oe |
| | $62 + 100 = 4x - x$ <br> or  $3x = 162$ | M1dep | oe <br> correct expansion and collection of terms |
| | $x = 54$ | A1 | |
| | $\dfrac{180 - 62 - \text{their } 54}{2}$ | M1dep | |
| | 32 | A1ft | ft their $x$ with first and third M1 gained |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **10** | $\dfrac{6x^9}{2x^4} + \dfrac{x^8}{2x^4}$  or  $3x^5$  or  $\dfrac{1}{2}x^4$ | M1 | |
| | $3x^5 + \dfrac{1}{2}x^4$ | A1 | |
| | $15x^4$  or  $2x^3$ | M1dep | differentiates at least one term correctly |
| | $60x^3 + 6x^2$ | M1dep | differentiates their 2-term $\dfrac{dy}{dx}$ correctly |
| | 9 | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **11** | $k^2 = 2(14k + 30)$ | M1 | oe correct equation with fractions eliminated |
| | $k^2 - 28k - 60 \ (= 0)$ | M1dep | oe equation |
| | $(k + 2)(k - 30) \ (= 0)$<br><br>or  $\dfrac{--28 \pm \sqrt{(-28)^2 - 4 \times 1 \times -60}}{2 \times 1}$<br><br>or  $14 \pm \sqrt{256}$ | M1 | oe<br><br>correct attempt to solve their 3-term quadratic equation |
| | 30 | A1 | 30 and −2 is A0 |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **12(a)** | $30x + 20x + 15x + 10x + 15x + y + y = 252$ <br><br> or $90x + 2y = 252$ | M1 | oe |
| | $y = \dfrac{252 - 90x}{2}$ <br><br> and $y = 126 - 45x$ | A1 | must see working for M1 |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **12(b)** | $30x \times 15x + 20x \times (126 - 45x)$ <br> or <br> $15x \times 10x + 20x \times (126 - 45x + 15x)$ <br> or <br> $15x \times 10x + 20x \times (126 - 30x)$ | M1 | oe |
| | $450x^2 + 2520x - 900x^2 = 2520x - 450x^2$ <br> or <br> $150x^2 + 2520x - 900x^2 + 300x^2$ <br> $= 2520x - 450x^2$ <br> or <br> $150x^2 + 2520x - 600x^2 = 2520x - 450x^2$ | A1 | must see correct expansion of brackets |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **12(c)** | $2520 - 900x$ | M1 | |
| | their $(2520 - 900x) = 0$<br><br>or $x = 2.8$ | M1dep | oe |
| | 3528 | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **13(a)** | $3 \times 4^2 + 6$ or $3 \times 16 + 6$ or $54$<br><br>or $\sqrt{3x^2 + 6 - 5}$ or $\sqrt{3x^2 + 1}$ | M1 | oe |
| | 7 | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **13(b)** | $3(x - 5) + 6$ | M1 | oe |
| | $3x - 9 = 3(x - 3)$ | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **14** | $\dfrac{\sin x}{2y} = \dfrac{\sin 18}{y}$ | M1 | oe |
| | $\sin x = 2 \sin 18$<br><br>or $\sin x = [0.61, 0.62]$<br><br>or $\sin^{-1} [0.61, 0.62]$<br><br>or $38.(17\ldots)$ or $38.(2)$ | M1dep | oe<br><br>eliminates $y$ |
| | $141.8\ldots$ or $142$ | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **15** | $a = 3$ | B1 | |
| | $0.48 =$ their $3 \times b^{-2}$ | M1 | oe |
| | $b^2 = \dfrac{\text{their } 3}{0.48}$ or $b^2 = 6.25$ <br><br> $\sqrt{\dfrac{\text{their } 3}{0.48}}$ or $\sqrt{6.25}$ | M1dep | oe |
| | $b = 2.5$ | A1ft | ft B0M2 |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **16** | (numerator =) $2x(4x^2 - 25)$ <br><br> or $\dfrac{4x^2 - 25}{6x^2 - x - 35}$ | B1 | |
| | (numerator =) $2x(2x + 5)(2x - 5)$ <br><br> or $\dfrac{(2x + 5)(2x - 5)}{6x^2 - x - 35}$ | B1 | |
| | $(ax + b)(cx + d)$ <br> where $ac = 6$ and $bd = \pm 35$ | M1 | |
| | $(3x + 7)(2x - 5)$ | A1 | |
| | $\dfrac{2x + 5}{3x + 7}$ | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **17** | $2x^2 - 3x = 7$ | M1 | at least two terms correct |
| | $2x^2 - 3x - 7 \ (= 0)$ | A1 | oe 3-term quadratic equation |
| | $\dfrac{--3 \pm \sqrt{(-3)^2 - 4 \times 2 \times -7}}{2 \times 2}$ <br><br> or $\dfrac{3}{4} \pm \sqrt{\dfrac{65}{16}}$ | M1 | oe <br><br> correct attempt to solve their 3-term quadratic equation |
| | 2.77 | A1 | 2.77 and – 1.27 is A0 |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **18** | 18 | B3 | B2  identifies there are 3 choices for first digit and 3 choices for second digit <br><br> B1  identifies there are 3 choices for first digit <br><br> or <br><br> identifies there is 1 choice for last digit |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **19(a)** | Identifies $(x =) -\dfrac{1}{3}$ | M1 | may be implied |
| | $3\left(-\dfrac{1}{3}\right)^3 - 2\left(-\dfrac{1}{3}\right)^2 - 7\left(-\dfrac{1}{3}\right) - 2 = 0$ <br><br> or $-\dfrac{1}{9} - \dfrac{2}{9} + \dfrac{7}{3} - 2 = 0$ | A1 | oe <br> must show four terms and equate to 0 |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **19(b)** | **Alternative method 1** | | |
| | $(3x + 1)(x^2 - x \ldots)$ <br> or <br><br> $3x + 1 \overline{)3x^3 + 4x^2 - 2x - 1}$ $\;\;x^2 - x \ldots$ | M1 | |
| | $(3x + 1)(x^2 - x - 2)$ <br> or <br><br> $3x + 1 \overline{)3x^3 + 4x^2 - 2x - 1}$ $\;\;x^2 - x - 2$ | A1 | |
| | $(3x + 1)(x + 1)(x - 2)$ | A1 | |
| | **Alternative method 2** | | |
| | $f(-1) = 0$  or  $f(2) = 0$ | M1 | |
| | $f(-1) = 0$  and  $f(2) = 0$ | A1 | |
| | $(3x + 1)(x + 1)(x - 2)$ | A1 | |
| | **Additional Guidance** | | |
| | | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **20** | $(VM^2 =)\ 10^2 - 3^2$  or  $100 - 9$  or  $91$ | M1 | oe |
| | $(DM^2 =)\ 8^2 + 3^2$  or  $64 + 9$  or  $73$ | M1 | oe |
| | $10^2 =$ their 91 + their 73 $- 2 \times \sqrt{\text{their } 91} \times \sqrt{\text{their } 73} \times \cos VMD$ | M1dep | oe <br> dep on M2 <br> may be implied |
| | $(\cos VMD =) \dfrac{\text{their } 91 + \text{their } 73 - 10^2}{2 \times \sqrt{\text{their } 91} \times \sqrt{\text{their } 73}}$ | M1dep | oe <br> dep on M3 |
| | [66.8, 66.9]  or  67 | A1 | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **21** | $4n^2 + 6n + 6n + 9$ <br> or  $4n^2 + 12n + 9$ | M1 | allow one error <br> implied by $4n^2 + 12n + k$ <br> or $an^2 + 12n + 9$ |
| | $8n^3 + 12n^2 + 24n^2 + 36n + 18n + 27$ | M1dep | oe <br> ft their $4n^2 + 6n + 6n + 9$ <br> allow one error |
| | $8n^3 + 36n^2 + 54n + 27$ <br> or  $9n^3 + 36n^2 + 54n + 27$ | A1 | |
| | $9n^3 + 36n^2 + 54n + 27$ <br> and $9(n^3 + 4n^2 + 6n + 3)$ | A1 | oe <br> eg  $(9n^3 + 36n^2 + 54n + 27) \div 9$ <br> $= n^3 + 4n^2 + 6n + 3$ <br> or <br> $9n^3 + 36n^2 + 54n + 27$ and all coefficients <br> are divisible by 9 |