Comparison of key skills specifications 2000/2002 with 2004 standardsX015461July 2004Issue 1

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Mark Scheme (Standardisation)

October 2020

Pearson Edexcel GCE Further Mathematics

Advanced Level in

Further Mathematics Paper 1 9FM0/01

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October 2020

Publications Code 9FM0\_01\_2010\_MS

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**General Marking Guidance**

* All candidates must receive the same treatment.  Examiners must mark the first candidate in exactly the same way as they mark the last.
* Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
* Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
* There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
* All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme.  Examiners should also be prepared to award zero marks if the candidate’s response is not worthy of credit according to the mark scheme.
* Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
* When examiners are in doubt regarding the application of the mark scheme to a candidate’s response, the team leader must be consulted.
* Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

**EDEXCEL GCE MATHEMATICS**

**General Instructions for Marking**

1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
* **M** marks: method marks are awarded for ‘knowing a method and attempting to apply it’, unless otherwise indicated.
* **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
* **B** marks are unconditional accuracy marks (independent of M marks)
* Marks should not be subdivided.
1. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

* bod – benefit of doubt
* ft – follow through
* the symbol will be used for correct ft
* cao – correct answer only
* cso - correct solution only. There must be no errors in this part of the question to obtain this mark
* isw – ignore subsequent working
* awrt – answers which round to
* SC: special case
* oe – or equivalent (and appropriate)
* dep – dependent
* indep – independent
* dp decimal places
* sf significant figures
* 🞸 The answer is printed on the paper
* The second mark is dependent on gaining the first mark
1. All A marks are ‘correct answer only’ (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **1(a)** | is also a root | B1 | 1.2 |
|  | B1 | 1.1b |
|  | M1 | 1.1b |
|  | M1 | 3.1a |
|  | A1 | 2.2a |
|  | B1 | 1.1b |
| B1ft | 1.1b |
|  | **(7)** |  |
|  | **(a) Alternative:** |  |  |
| is also a root | B1 | 1.2 |
|  | B1 | 1.1b |
|  | M1 | 1.1b |
|  | M1 | 3.1a |
|  | A1 | 2.2a |
| Then B1 B1ft as above |  |  |
|  | **(7)** |  |
| **(b)** | or | M1 | 3.1a |
|  **or**  | A1 | 1.1b |
| **and**  | A1 | 1.1b |
|  | **(3)** |  |
|  | **(b) Alternative:** |  |  |
|  |  | M1 | 3.1a |
|  **or**  | A1 | 1.1b |
| **and**  | A1 | 1.1b |
|  | **(3)** |  |
| **(10 marks)** |
| **Notes** |
| (a)B1: Identifies the correct complex conjugate as another rootB1: Correct values for the sum and product for the conjugate pairM1: Correct application of the pair sumM1: Identifies a complete and correct strategy for identifying the third rootA1: Deduces the correct third rootB1: plotted correctlyB1ft: Their real root plotted correctly**Alternative:**B1: Identifies the correct complex conjugate as another rootB1: Correct quadratic factor obtainedM1: Expands their quadratic×(3*z* + “*a*”)M1: Compares z coefficients to establish the value of “*a*”A1: Deduces the correct third rootB1: plotted correctlyB1ft: Their real root plotted correctly(b)M1: Correct strategy used for identifying at least one of *p* or *q*A1: At least one value correctA1: Both values correct**Alternative:**M1: Correct strategy by expanding their quadratic and linear factors to identifying at least one of *p* or *q*A1: At least one value correctA1: Both values correct |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **2(a)** | Because the upper limit is infinity | B1 | 2.4 |
|  | **(1)** |  |
| **(b)** |  | M1 | 3.1a |
|  | A1 | 1.1b |
|  | A1ft | 1.1b |
|  | M1 | 2.1 |
|  | B1 | 2.2a |
|  | A1 | 1.1b |
|  | **(6)** |  |
| **(7 marks)** |
| **Notes** |
| (a)B1: Correct explanation(b)M1: Selects the correct form for partial fractions and proceeds to find values for *A* and *B*A1: Correct constants or partial fractionsA1ft: M1: Combines logs correctlyB1: Correct upper limit for *x* 🡪 ∞ by recognising the dominant terms. (Simply replacing *x* with ∞ scores B0)A1: Deduces the correct value for the improper integral in the correct form |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **3** |  | M1 | 3.1a |
|  | A1 | 1.1b |
| Use of  or  | M1 | 1.1a |
| Correct strategy e.g.  or | M1 | 3.1a |
|  | A1 | 1.1b |
|  | M1 | 3.1a |
|  | A1 | 1.1b |
|  | M1 | 2.1 |
| =  | A1 | 1.1b |
|  |  | **(9)** |  |
| **(9 marks)** |
| **Notes** |
| M1: Realises that the angles at the intersection are required and solves *C*1 = *C*2 to obtain a value for *θ*A1: Correct value for *θ*M1: Evidence of the use of a correct polar area formula on either curveM1: Uses a correct strategy to find the required areaA1: Correct expansions for both curves (may be unsimplified)M1: Selects the correct strategy by applying the correct double angle identity in order to reach an integrable formA1: Correct integrationM1: Applies limits correctly to their integration and combines terms A1: Correct area |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **4(a)** | Attempts normal vector:E.g. let then *a* + 2*b* – 3 = 0, – *a* + 2*b* + 1 = 0or | M1 | 3.1a |
|  | A1 | 1.1b |
|  | M1 | 1.1b |
|  | A1 | 2.5 |
|  | **(4)** |  |
| Alternative: |  |  |
|  | M1A1 | 3.1a1.1b |
|  | M1A1 | 1.1b2.5 |
|  | **(4)** |  |
| **(b)** |  | M1 | 3.1a |
|  | M1 | 1.1b |
|  | A1 | 1.1b |
|  | **(3)** |  |
| **(c)** |  | M1 | 1.1b |
|  | A1 | 1.1b |
|  | **(2)** |  |
| **(9 marks)** |
| **Notes** |
| (a)M1: Starts by attempting to find a normal vector using a correct methodA1: Obtains a correct normal vectorM1: Attempts scalar product between their normal and a point in the planeA1: Correct Cartesian form (accept any equivalent form)AlternativeM1: Uses the component form to eliminate one of the scalar parametersA1: Two correct equations with one parameter eliminatedM1: Forms a Cartesian equation A1: Correct Cartesian equation (accept any equivalent form)(b)M1: Correctly interprets the Cartesian form to give a parametric form and substitutes this into their Cartesian equation and proceeds to find a value for their parameterM1: Substitutes their parameter value back into the parametric form of the lineA1: Correct coordinates(c)M1: Complete and correct scalar product method leading to a value for *θ*A1: Correct angle |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **5(a)** |  | B1 | 1.1b |
|  | M1 | 2.1 |
|  | A1\* | 1.1b |
|  | **(3)** |  |
| **(b)** |  | M1 | 3.4 |
|  | A1 | 1.1b |
|  | M1 | 3.4 |
|  | A1 | 1.1b |
| PI: Try  | M1 | 3.4 |
|  | A1ft | 1.1b |
|  | **(6)** |  |
| **(c)** |  | B1ft | 1.1b |
|  | M1 | 3.4 |
|  | A1 | 1.1b |
|  | **(3)** |  |
| **(d)** |  | M1 | 3.1b |
|  | M1 | 3.3 |
|  | A1 | 2.2a |
|  | A1 | 2.2a |
|  | **(4)** |  |
| **(e)** | When *t* > 8, the amount of compound *X* and the amount of compound *Y* remain (approximately) constant at 10 and 8 respectively, which suggests that the chemical reaction has stopped. This supports the scientist’s claim. | B1 | 3.5a |
|  | **(1)** |  |
| **(17 marks)** |
| **Notes** |
| (a)B1: Differentiates the first equation with respect to *t* correctlyM1: Uses the second equation to eliminate *y* and proceeds to printed answerA1\*: Achieves the printed answer with no errors(b)M1: Uses the model to form and solve the auxiliary equationA1: Correct roots of the AEM1: Uses the model to form the complementary functionA1: Correct CFM1: Chooses the correct form of the PI according to the model and uses a complete method to find the PIA1ft: Combines their CF and PI to give *x* in terms of *t*(c)B1ft: Correct differentiation of their *x*. Follow through their M1: Uses the model and their answer to part (b) to give *y* in terms of *t*A1: Correct equation(d)M1: Realises the need to use the initial conditions in the equation for *x*M1: Realises the need to use the initial conditions in the equation for *y* to find both unknown constantsA1: Deduces the correct equation for *x*A1: Deduces the correct equation for *y*(e)B1: Realises that, for values of *t* > 8, the amounts of compounds *X* and *Y* present do not vary, which supports the claim |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **6(i)** | When *n* = 1, so the statement is true for *n* = 1 | B1 | 2.2a |
| Assume true for *n* = *k* so  | M1 | 2.4 |
|  | M1 | 2.1 |
|  | A1 | 1.1b |
|  | A1 | 1.1b |
| If the statement is true for *n* = *k* then it has been shown true for *n* = *k* + 1 and as it is true for *n* = 1, the statement is true for all positive integers *n*. | A1 | 2.4 |
|  | **(6)** |  |
| **(ii)****Way 1** | When *n* = 1, so the statement is true for *n* = 1 | B1 | 2.2a |
| Assume true for *n* = *k* so is divisible by 15 | M1 | 2.4 |
|  | M1 | 2.1 |
|  | A1A1 | 1.1b1.1b |
| If true for *n* = *k* then true for *n* = *k* + 2, true for *n* = 1 so true for all (positive odd integers) *n* | A1 | 2.4 |
|  | **(6)** |  |
| **(ii)****Way 2** | When *n* = 1, so the statement is true for *n* = 1 | B1 | 2.2a |
| Assume true for *n* = *k* so is divisible by 15 | M1 | 2.4 |
|  | M1 | 2.1 |
|  | A1 | 1.1b |
|  | A1 | 1.1b |
| If true for *n* = *k* then true for *n* = *k* + 2, true for *n* = 1 so true for all (positive odd integers) *n* | A1 | 2.4 |
|  |  | **(6)** |  |
| **(12 marks)** |
| **Notes** |
| (i)B1: Shows the statement is true for *n* = 1M1: Makes an assumption statement that assumes the result is true for *n* = *k*M1: Attempts to add the (*k* + 1)th term to the assumed resultA1: Correct expression with at least one correct linear factorA1: Obtains a fully correct expression in terms of *k* + 1A1: Correct complete conclusion with all ideas conveyed at the end or as a narrative(ii) **Way 1**B1: Shows that f(1) = 15M1: Makes a statement that assumes the result is true for some value of *n* (Assume (true for) *n* = *k* is sufficient – note that this may be recovered in their conclusion if they say e.g. if true for *n* = *k* then … etc.)M1: Attempts f(*k* + 2)A1: Correctly obtains 16f(*k*) **or** A1: Reaches a correct expression for f(*k* + 2) in terms of f(*k*)A1: Correct conclusion. This mark is dependent on all previous marks apart from the B mark. It is gained by conveying the ideas of **all** four underlined points **either** at the end of their solution **or** as a narrative in their solution.**Way 2**B1: Shows that f(1) = 15M1: Makes a statement that assumes the result is true for some value of *n* (Assume (true for) *n* = *k* is sufficient – note that this may be recovered in their conclusion if they say e.g. if true for *n* = *k* then … etc.)M1: Attempts f(*k* + 2) – f(*k*) or equivalent work A1: Achieves a correct expression for f(*k* + 2) – f(*k*) in terms of f(*k*)A1: Reaches a correct expression for f(*k* + 2) in terms of f(*k*)A1: Correct conclusion. This mark is dependent on all previous marks apart from the B mark. It is gained by conveying the ideas of **all** four underlined points **either** at the end of their solution **or** as a narrative in their solution. |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **7(a)** |  | B1 | 1.1b |
|  | M1 | 3.1b |
|  | A1 | 1.1b |
|  | M1 | 3.4 |
|  | M1 | 1.1b |
| = 10 277 bacteria (allow awrt 10 300) | A1 | 2.2b |
|  | **(6)** |  |
| **(b)** |  | M1A1 | 3.41.1b |
|  | M1 | 3.1a |
|  bacteria per hour | A1 | 3.2a |
|  | **(4)** |  |
|  | **(b) Alternative:** |  |  |
|  | M1 | 3.4 |
|  | A1 | 1.1b |
|  | M1 | 3.1a |
|  bacteria per hour | A1 | 3.2a |
|  | **(4)** |  |
| **(c)** | E.g.* The number of bacteria increases indefinitely which is not realistic
 | B1 | 3.5b |
|  | **(1)** |  |
| **(11 marks)** |
| **Notes** |
| (a)B1: A correct rearrangement (may be implied by subsequent work)M1: Uses the model to find the integrating factor and attempts the solution of the differential equationA1: Correct solutionM1: Interprets the initial conditions to find the constant of integrationM1: Uses their solution to the problem to find the population after 8 hoursA1: Correct number of bacteria (accept awrt 10 300)(b)M1: Realises the need to differentiate the model and uses an appropriate method to find the derivativeA1: Correct differentiationM1: Uses *t* = 4 in their d*P*/d*t*A1: Correct answer (awrt 1074 or 1075) with correct units**Alternative:**M1: Substitutes *t* = 4 into their *P*A1: Correct value for *P*M1: Uses *t* = 4 and their *P* to find a value for d*P*/d*t*A1: Correct answer (awrt 1074 or 1075) with correct units(c)B1: Suggests a suitable limitation |

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