**GCE AS Further Mathematics (8FM0) – Paper 25**

**Further Mechanics 1**

**Summer 2018**

**Summer 2018 student-friendly mark scheme**

**Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide to good practice, indicating where marks are given for correct answers. As such, it doesn’t show follow-through marks (marks that are awarded despite errors being made) or special cases.**

**It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme.**

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| **Guidance on the use of codes within this document** |
| M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect.  A1 – accuracy mark. This mark is generally given for a correct answer following correct working.  B1 – working mark. This mark is usually given when working and the answer cannot easily be separated.  Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer). |

**Question 1 (Total 5 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | *v*2 = *u*2 + 2*as*  2 × 9.8 × 3.6 = 70.56 | M1 | This mark is given for using the model and the correct *suvat* equation for a method to find the speed of the ball before impact |
| *v* = 8.4 m s–1 | A1 | This mark is given for a correct answer only |
| *I* = *mv* – *mu*  4.2 = 0.3(*w* – (–8.4)) | M1 | This mark is given for using the model and the impulse-momentum equation, using the given impulse the speed of impact |
| *w* = – 8.4 | A1 | This mark is given for a correct expression for the speed of the ball immediately after it hits the ground. |
| *w* = 5.6 m s–1 | A1 | This mark is given for a correct answer only |
| (b) | KE lost = *m*(*v*2 – *w*2) | M1 | This mark is given for a correct method to find the kinetic energy lost |
| = (8.42 – 5.62) | A1 | This mark is given for a correct expression using speeds of the ball before and after impact |
| = 5.88 (J) | A1 | This mark is given for a correct answer only |

**Question 2 (Total 9 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | Work-energy equation:  kinetic energy lost =  potential energy gained + work done | M1 | This mark is given for correctly quoting the work-energy equation |
| 2.5*R*  = | A1 | This mark is given for a correct term for kinetic energy lost |
| × 4 × 52 – 4 × *g* × 2.5 × | A1 | This mark is given for a correct term for potential energy gained + work done |
| 2.5*R* = 22  *R* = 8.8 | A1 | This mark is given for a correct conclusion with sufficient working shown to justify given answer |
| (b) | Work-energy equation:  Kinetic energy after =  initial kinetic energy – 2 × work done | M1 | This mark is given for correctly quoting work-energy equation considering *A* to *A* or *B* to *A* |
| × 4 × *v*2 =  × 4 × 25 – 2 × 8.8 × 2.5 | A1 | This mark is given for a correct equation for kinetic energy after |
| 2*v*2 = 6  *V* = 1.7 m s–1 | A1 | This mark is given for the correct answer only |
| (c) | The model has assumed a constant resistance, so have a variable resistance or have air resistance proportional to speed  Do not model the parcel as a particle so that the possibility that the parcel rotates as it moves up or down the slope can be considered  Consider the dimensions of the parcel | B2 | These marks are given for two valid improvements stated |

**Question 3 (Total 9 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | *P* = *Fv* | B1 | This mark is given for the use of *P* = *Fv* seen or implied |
| Equation of motion:  *F* – *λv* = 750 × 0.6 | M1 | This mark is given for an equation of motion using all three terms |
| – *λ* × 15 = 750 × 0.6 | A1 | This mark is given for a correct (unsimplified) equation |
| 1200 – 15*λ* = 450  *λ* = 50 | A1 | This mark is given for a correct answer only |
| (b) | Equation of motion:  – 50*V* – 750*g* sin *α* | M1 | This mark is given for an equation of motion using all three terms |
| – 50*V* – 490 = 0 | A1 | This mark is given for a correct equation with substitutions for *g* and sin *α* |
| 5*V* 2 + 49*W* – 1200 = 0 | A1 | This mark is given for a correct quadratic equation |
| *V* = | A1 | This mark is given for an attempt to solve the quadratic equation |
| 11.3 | A1 | This mark is given for a correct answer only |

**Question 4 (Total 14 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) |  | M1 | *Complete strategy e.g. use of CLM, impact law and solution of simultaneous equations* |
| 2*u* × 3*m* – *u* × 5*m* = 3*mv* – 5*mw* | M1 | This mark is given for an attempt to form a Conservation of Linear Momentum equation |
| 6*mu* – 5*mu* = 3*mv* + 5*mw*  *mu* = 3*mv* + 5*mw* | A1 | This mark is given for a correct (unsimplified) equation with all terms and dimensionally correct |
|  | M1 | This mark is given for use of the impact law |
| *w* – *v* = 3*ue* | A1 | This mark is given for a correct (unsimplified) equation |
| *u* = 3*v* + 5*w* and 3*w* – 3*v* = 9*ue*  ⇒ 8*w = u* +9*ue*, *w* = (9*e* + 1) | A1 | This mark is given for the correct answer shown in the question from correct working |
| (b) | *v* = *w* – 3*ue*  = (9*e* + 1 – 24*e*)  = (1 – 15*e*) | M1 | This mark is given for an attempt to find the speed of *P* and form an inequality |
| *e* < | A1 | This mark is given for the correct answer only |
| (c) |  | M1 | *Complete strategy to find time for Q to get to second collision e.g. time to wall and back again* |
| Speed of *Q* = | B1 | This mark is given for the correct use of the impact law to find the speed of *Q* after impact with the wall |
|  |  |  |
| Time for *Q* =  + | A1 | This mark is given for a correct (unsimplified) equation using  time = |
| = | B1 |  |
|  | M1 | This mark is given for an attempt to find *x* by putting both particles in the same place at the same time |
| *x* =  = | A1 | This mark is given for the correct answer only |