**GCE A level Mechanics (9MA0) – Paper 32**

**Mechanics**

**October 2021 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.**

**This document is intended for guidance only and may differ significantly from the final mark scheme published in December 2021.**

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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 – accuracy 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 4 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | Use of **v** = **u** + **a***t* with *t* = 2: **v** = 4**i** + 2 | M1 | This mark is given for complete method to find **v** |
|  | A1 | This mark is given for the correct velocity. |
| (b) | at *t* = 3: | M1 | This mark is given for correct method to find the position vector. |
|  |  | A1 | This mark is given for correct position vector. |

**Question 2 (Total 12 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| **(a)** | Equation of motion for *A* | M1 | This mark is given for equation in *T* and *a* with correct number of terms. |
| A1 | This mark is given for the correct equation. |
| **(b)** | Resolve perpendicular to the plane | M1 | This mark is given for correct number of terms. |
| A1 | This mark is given for the correct equation. |
|  | B1 | This mark is given for stating . |
| Equation of motion for whole system | M1 | This mark is given for the equation in T and a with correct number of terms. |
| A1 | This mark is given for the correct equation. |
|  | M1 | This mark is given for the correct method. |
| A1 | This mark is given for the complete working to show the correct expression of *a*. |
| **(c)** | *v*        *t* | B1 | This mark is given for a straight line starting at the origin. |
| acceleration of *B* is constant | B1 | This mark is given for a suitable statement. |
| **(d)** | the tensions in the two equations of motion would be different.  Tension on *A* would be different to tension on *B* | B1 | This mark is given for a suitable statement. |

**Question 3 (Total 10 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| **(a)** | *C* *S B*  *G*  *R mg*  *D*  *A* *F* |  |  |
| Moments equation:  M(*A*),  M(*B*),  M(*C*),  M(*D*),  M(*G*), | M1 | This mark is given for any moments equation with correct terms. |
| A1 | This mark is given for the correct equation. |
| () *R* = *mg*  () *F* = *S* | B1 | This mark is given for the correct equation. |
|  | M1 | This mark is given for using the equations and to give an inequality inand  only. |
| A1 | This mark is given for fully correct working to achieve the given answer. |
|  |  |  |  |
| **(b)** | *C* *N B*  *G*  *R mg*  *D*  *A* *kmg* |  |  |
| Moments equation:  M(*A*),  M(*B*),  M(*D*),  M(*G*), | M1 | This mark is given for any moments equation with correct terms. |
| A1 | This mark is given for correct equation. |
| *R* = *mg* | B1 | This mark is given for correct equation. |
|  | M1 | This mark is given for using the equations with trig substituted to solve for *k*. |
|  | A1 | This mark is given for the correct value. |

**Question 4 (Total 10 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | **Note that *g* = 10; penalise once for whole question if *g* = 9.8** |  | This mark is given for |
| **(a)** | Solve  vertically | M1 | This mark is given for the complete method with correct number of terms. |
| A1 | This mark is given for correct equation with at most one error. |
| M1 | This mark is given for correct equation in *t* only. |
| *t* = 7 s | A1 | This mark is given for the correct value. |
| **(b)** | Horizontal velocity component at *A* | B1 | This mark is given for correct horizontal velocity component. |
| vertical velocity component at *A* | M1 | This mark is given for complete method to find vertical velocity component at *A*. |
| A1 | This mark is given for the correct value. |
| the speed of the stone at the instant just before it hits the ground at *A*  = | M1 | This mark is given for substituting for the trig and square, add and square root. |
| = 75 | A1 | This mark is given for the correct value. |
| **(c)** | An approximate value of *g* has been used, the dimensions of the stone could affect its motion, spin of the stone, *g* = 10 instead of 9.8 has been used, *g* has been assumed to be constant, wind effect, shape of the stone | B1 | This mark is given for stating a suitable limitation. |

**Question 5 (Total 14 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| **(a)** |  | M1 | This mark is given for differentiation **v** with respect to **t**. |
| A1 | This mark is given for the correct acceleration. |
| **(b)** |  | M1 | This mark is given for using complete method using **v** to obtain an equation in *t* only. |
|  | M1 | This mark is given for solving for *t*. |
|  | A1 | This mark is given for correct value of *t*. |
| **(c)** |  | M1 | This mark is given for integrate **v** with respect to *t*. |
|  | A1 | This mark is given for correct expression. |
| *t* = 1, **r =**  **C** = | A1 | This mark is given for correct answer only. |
| **(d)** |  | M1 | This mark is given for using Pythagoras on **v** and 10 to set up an equation in *t*. |
|  | M1 | This mark is given for correct expression without **C**. |
| *t* = 4 | A1 | This mark is given for correct answer only. |
|  | M1 | This mark is given for substituting *t* into **r**. |
|  | M1 | This mark is given for using Pythagoras to find the magnitude of **r**. |
| m | A1 | This mark is given for correct solution only. |