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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **1a** | (can be inferred from working) | **M1** | 1.2 | 2ndUnderstand the definition of kinetic energy |
| 0.5 × 2 × 52 = 25 J (must include units) | **A1** | 1.1b |
|  | **(2)** |  |  |
| **1b** | GPE = *m*g*h* (can be inferred from working) | **M1** | 1.2 | 3rdUnderstand the concept of gravitational potential energy |
| 2 × *g* × 0.1 = 0.2*g* J or 1.96 J (must include units, allow awrt 2.0 J) | **A1** | 1.1b |
|  | **(2)** |  |  |
| **1c** | Using ratio to deduce, *m*2= 1.5*m*1 o.e.Equating KE and PE correctly, 0.5*m*1υ2 = *m*2g*h* | **M1** | 3.1a | 6thSolve simple problems involving work and energy |
| Substituting to eliminate *m*2 (or *m*1) 0.5*m*1υ2 = 1.5*m*1g*h* | **M1** | 1.1a |
| Rearrange for final answer,  | **A1** | 1.1b |
|  | **(3)** |  |  |
| (7 marks) |
| Notes |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **2a** | WD = *F* × *d*  | **M1** | 1.2 | 3rdUnderstand the formula for and units of work |
| 80 × 10 = 800 J | **A1** | 1.1b |
|  | **(2)** |  |  |
| **2b** | Same block, same distance and WD is equal so **force in direction of motion is equal.** (can beinferred from working) | **M1** | 2.2b | 2ndUnderstand the definition of work |
| F cos(20) = 80 so F = 85 N | **A1** | 1.1b |
|  | **(2)** |  |  |
| **2c** | Use WD = *F* × *d* in the given formula,Power = WD ÷ *t* | **M1** | 2.1 | 3rdUnderstand the concept of power |
| So Power = (*F* × *d*) ÷ *t*So Power = *F* × (*d* ÷ *t)* = *F* × υ because υ = *d* / *t* | **A1** | 2.1 |
|  | **(2)** |  |  |
| **2di** | Power was greater in part **a** as same work done in shorter time | **B1** | 2.4 | 4thCalculate power |
|  | **(1)** |  |  |
| **2dii** | Distance travelled vertically is zero because resultant vertical force is zero as 85 sin 20 + normal reaction = 80 gNo distance vertically, means no work done vertically, so no power output | **B1** | 2.4 | 5thUse the formula for power in problem solving |
|  | **(1)** |  |  |
| (8 marks) |
| Notes |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **3a** | Work-energy Principle,WD against resistance = loss in KE | **M1** | 1.2 | 4thUnderstand that work done on a body in a horizontal plane is change in kinetic energy |
| So | **M1** | 3.1a |
| So *F*drag = 156.25 N | **A1** | 1.1b |
|  | **(3)** |  |  |
| **3b** |  o.e. | **M1** | 3.1a | 4thUnderstand that work done on a body in a horizontal plane is change in kinetic energy |
| So *m* = 51.3136… | **A1** | 1.1b |
| So *m* = 51.3 kg to 3 SF (units and correct rounding) | **A1** | 1.1b |
|  | **(3)** |  |  |
| **3c** |  | Diagram with key facts correctly clearly labelled  | **M1** | 3.1b | 4thBe able to include GPE when applying the work-energy principle |
| WD against *F*r = Loss in ME40*g*cos(30) × *μ* × 9  | **M1** | 1.2 |
| = 20(252 − 222) – 40*g*(9sin(30)) | **M1** | 3.1a |
| *μ* = 0.345 | **A1** | 1/1b |
|  | **(4)** |  |  |
| (10 marks) |
| Notes |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **4a** | Assumed perfectly smooth means no energy lost to friction so conservation of mechanical energy applies, | **B1** | 2.2a | 5thUnderstand and use the principle of the conservation of mechanical energy |
| (KE + PE)top of chute = (KE + PE)bottom of chute | **M1** | 1.2 |
| Use max speed of 2 ms–1 to find max angle (can be implied) | **M1** | 3.4 |
| 0.5(1.5)(0.5)2 + 1.5(9.8)(2sin*θ*) ⩽ 0.5(1.5)(2)2 [+ 0] | **M1** | 3.1a |
| So *θ* = 5.49° is the maximum to 3 sf | **A1** | 1.1b |
|  | **(5)** |  |  |
| **4b** | WD against friction = loss in ME | **M1** | 3.1b | 4thBe able to include GPE when applying the work-energy principle |
| (0.05)(1.5gcos(7))(2) = 0.5(1.5)(0.5)2 + 1.5(9.8)(2sin(7)) – 0. 5(1.5)υ2 | **M1** | 3/1a |
| υ = 1.76 | **A1** | 1/1b |
| υ< 2 ms–1 so yes (arrangement still satisfies the condition) | **B1** | 3/2a |
|  | **(4)** |  |  |
| (9 marks) |
| Notes |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **5a** |  | Diagram showing forces and decelaration (or –ve accn) | **M1** | 3.1b | 5thUse the formula for power in problem solving |
| Attempt use of F = *ma* to find *D*  | **M1** | 1.1a |
| *D* – 35gsin(10) – 12 = 5(−0.2) | **M1** | 3.1a |
| *D* = 64.561 awrt 64.6 | **A1** | 1.1b |
| So Power = (their *D*) × 3  | **M1** | 1.2 |
| Power = 194 W (to 3 sf) | **A1** | 1.1b |
|  | **(6)** |  |  |
| **5b** | Work against non-gravitational resistance = Loss in ME | **M1** | 1.2 | 4thBe able to include GPE when applying the work-energy principle |
| 12(d) = 0.5(35)(1.52) – 35(9.8)(dsin(10)) | **M1** | 3.1a |
| 71.561(d) = 39.375 | **M1** | 1.1b |
| d = 0.55 m | **A1** | 1.1b |
|  | **(4)** |  |  |
| (10 marks) |
| Notes |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **6a** |  | As *D* α υ so *D* = kυ | **M1** | 3.1a | 6thSolve simple problems involving work and energy |
| At terminal velocity (υ = 0.8 constant) so resultant force = 0 | **M1** | 2.2b |
| 0.0125*g* = 0.8*k* + 0.015*k* = 1.25(0.0125*g* – 0.015) | **M1** | 3.1a |
| Thus  | **A1** | 1.1b |
|  | **(4)** |  |  |
| **6b** | Energy lost is GPE only as υ is constant, so KE constant0.0125*gh* = 30 J | **M1** | 3.3 | 7thSolve problems involving work and energy in unfamiliar contexts |
| *h* = 244.90 m to 2 dpDepth of lake = 244.9 + 1.1 = 246 m to 3 sf | **B1** | 3.4 |
|  | **(2)** |  |  |
| (6 marks) |
| Notes |