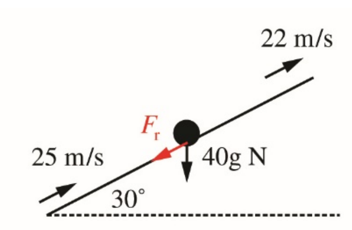
Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
1a	$KE = \frac{1}{2}mv^2$ (can be inferred from working) $0.5 \times 2 \times 5^2 = 25$ J (must include units)	M1 A1	1.2 1.1b	2nd Understand the definition of kinetic energy
		(2)		
1b	GPE = mgh (can be inferred from working) $2 \times g \times 0.1 = 0.2g$ J or 1.96 J (must include units, allow awrt 2.0 J)	M1 A1	1.2 1.1b	3rd Understand the concept of gravitational potential energy
		(2)		
1c	Using ratio to deduce, $m_2 = 1.5m_1$ o.e. Equating KE and PE correctly, $0.5m_1v^2 = m_2gh$ Substituting to eliminate m_2 (or m_1) $0.5m_1v^2 = 1.5m_1gh$ Rearrange for final answer, $h = \frac{v^2}{3g}$	M1 M1 A1	3.1a 1.1a 1.1b	6th Solve simple problems involving work and energy
		(3)		
				(7 marks)

Notes

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

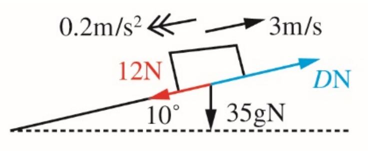
Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
3a	Work-energy Principle, WD against resistance = loss in KE So $F_{\text{drag}} \times 100 = \frac{1}{2} \times 50 \times 25^2 [-0]$ So $F_{\text{drag}} = 156.25$ N	 M1 M1 A1	 1.2 3.1a 1.1b	4th Understand that work done on a body in a horizontal plane is change in kinetic energy
		(3)		
3b	$156.25 \times 100 = \frac{1}{2} \times m \times (25^2 - 4^2)$ o.e. So $m = 51.3136\ldots$ So $m = 51.3$ kg to 3 SF (units and correct rounding)	M1 A1 A1	3.1a 1.1b 1.1b	4th Understand that work done on a body in a horizontal plane is change in kinetic energy
		(3)		
3c	 Diagram with key facts correctly clearly labelled WD against F_r = Loss in ME $40g\cos(30) \times \mu \times 9$ $= 20(25^2 - 22^2) - 40g(9\sin(30))$ $\mu = 0.345$	M1 M1 M1 A1	3.1b 1.2 3.1a 1/1b	4th Be able to include GPE when applying the work-energy principle
		(4)		
				(10 marks)

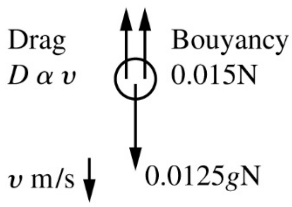
Notes

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	5th Understand and use the principle of the conservation of mechanical energy
	$(KE + PE)_{\text{top of chute}} = (KE + PE)_{\text{bottom of chute}}$	**M1**	1.2	
	Use max speed of 2 ms^{-1} to find max angle (can be implied)	**M1**	3.4	
	$0.5(1.5)(0.5)^2 + 1.5(9.8)(2\sin\theta) \leqslant 0.5(1.5)(2)^2$ [+ 0]	**M1**	3.1a	
	So $\theta = 5.49°$ is the maximum to 3 sf	**A1**	1.1b	
		(5)		
4b	WD against friction = loss in ME	**M1**	3.1b	4th Be able to include GPE when applying the work-energy principle
	$(0.05)(1.5g\cos(7))(2) = 0.5(1.5)(0.5)^2 + 1.5(9.8)(2\sin(7)) - 0.5(1.5)\upsilon^2$	**M1**	3/1a	
	$\upsilon = 1.76$	**A1**	1/1b	
	$\upsilon < 2$ ms^{-1} so yes (arrangement still satisfies the condition)	**B1**	3/2a	
		(4)		
				(9 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
5a	 Diagram showing forces and decelaration (or –ve accn)	M1	3.1b	5th Use the formula for power in problem solving
	Attempt use of F = ma to find D	M1	1.1a	
	$D - 35g\sin(10) - 12 = 5(-0.2)$	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	4th Be able to include GPE when applying the work-energy principle
	$12(d) = 0.5(35)(1.5^2) - 35(9.8)(d\sin(10))$	M1	3.1a	
	$71.561(d) = 39.375$	M1	1.1b	
	$d = 0.55$ m	A1	1.1b	
		(4)		
				(10 marks)

Notes

Q	Scheme		Marks	AOs	Pearson Progression Step and Progress Descriptor
6a		As D α υ so $D = k\upsilon$	**M1**	3.1a	6th Solve simple problems involving work and energy
		At terminal velocity (υ = 0.8 constant) so resultant force = 0	**M1**	2.2b	
		$0.0125g = 0.8k + 0.015$ $k = 1.25(0.0125g - 0.015)$	**M1**	3.1a	
		Thus $D = \left(\frac{1}{320}\right)(5g - 6)\upsilon$ N	**A1**	1.1b	
			(4)		
6b	Energy lost is GPE only as υ is constant, so KE constant $0.0125gh = 30$ J		**M1**	3.3	7th Solve problems involving work and energy in unfamiliar contexts
	$h = 244.90$ m to 2 dp Depth of lake = 244.9 + 1.1 = 246 m to 3 sf		**B1**	3.4	
			(2)		
					(6 marks)

Notes