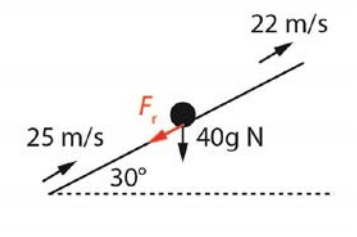
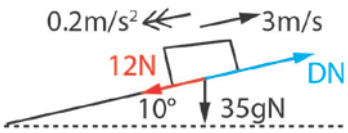
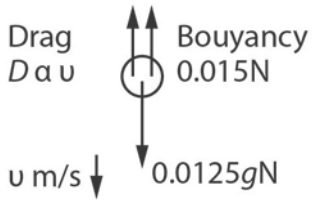
Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1a	KE = $\frac{1}{2}mv^2$ (can be inferred from working) $0.5 \times 2 \times 5^2 = 25$ J (must include units)	**M1** **A1**	1.2 1.1b	TBC
		(2)		
1b	GPE = mgh (can be inferred from working) $2 \times g \times 0.1 = 0.2g$ J or 1.96 J (must include units, allow awrt 2.0 J)	**M1** **A1**	1.2 1.1b	TBC
		(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	TBC
		(3)		
				(7 marks)
Notes				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2a	WD = $F \times d$ $80 \times 10 = 800$ J	**M1** **A1**	1.2 1.1b	TBC
		(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	TBC
		(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	TBC
		(2)		
2di	Power was greater in part (**a)** as same work done in shorter time	**B1**	2.4	TBC
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	TBC
		(2)		
				(8 marks)
Notes				

Q	Scheme		Marks	AOs	Pearson Progression Step and Progress descriptor
3a	Work-energy pPrinciple, WD against resistance = loss in KE So $F_{drag} \times 100 = ½ \times 50 \times 25^2$ [- 0] So F_{drag} = 156.25 N		 **M1** **M1** **A1**	 1.2 3.1a 1.1b	TBC
			(3)		
3b	$156.25 \times 100 = ½ \times m \times (25^2 - 4^2)$ o.e. So m = 51.3136… So m = 51.3 kg to 3 SF (units and correct rounding)		**M1** **A1** **A1**	3.1a 1.1b 1.1b	TBC
			(3)		
3c		Diagram with key facts correctly clearly labelled WD against F_r = Loss in ME $40g\cos(30) \times \mu \times 9$ $= 20(25^2 - 22^2) - 40g(9\sin(30))$ μ = 0.345	**M1** **M1** **M1** **A1**	3.1b 1.2 3.1a 1/1b	TBC
			(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	TBC
	$(KE + PE)_{\text{top of chute}} = (KE + PE)_{\text{bottom of chute}}$	**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	TBC
	$(0.05)(1.5g\cos(7))(2) = 0.5(1.5)(0.5)^2 + 1.5(9.8)(2\sin(7)) - 0.5(1.5)\upsilon^2$	**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 deceleration (or –ve accn)	**M1**	3.1b	TBC
		Attempt use of F = *ma* to find *D*	**M1**	1.1a	
		$D - 35g\sin(10) - 12 = 35(-0.2)$	**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	TBC
	$12(d) = 0.5(35)(1.5^2) - 35(9.8)(d\sin(10))$		**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 $D \alpha \upsilon$ so $D = k\upsilon$	**M1**	3.1a	TBC
		At terminal velocity ($\upsilon = 0.8$ 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 $D = (^1/_{320})(5g - 6)\upsilon$ N	**A1**	1.1b	
			(4)		
6b	Energy lost is GPE only as υ is constant, so KE constant $0.0125gh = 30$ J $h = 244.90$ m to 2 dp Depth of lake = 244.9 + 1.1 = 246 m to 3 sf		**M1** **B1**	3.3 3.4	TBC
			(2)		
					(6 marks)
Notes					