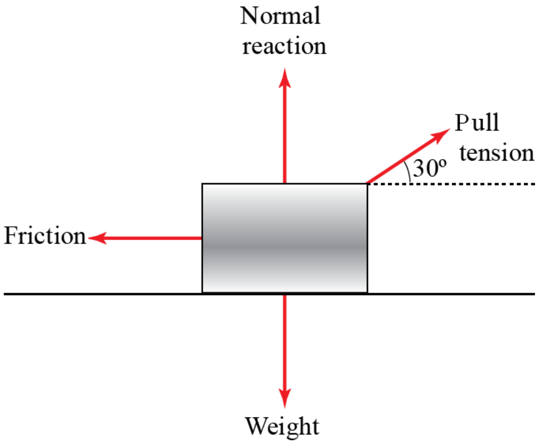
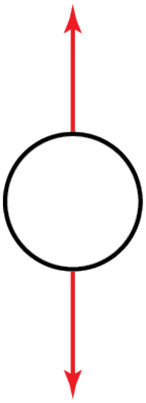
Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4.1a	Force = 4 × 9.8 = 39.2 (N). Accept 39.	**M1**	1.1b	4th Calculate moments.
	Moment = force × distance	**M1**	1.1a	
	Moment = 39.2 × 3 = 117.6 (N m). Accept 118.	**A1**	1.1b	
		(3)		
4.1b	Moment = $F \times 7 = 7F$ (N m)	**A1**	1.1b	4th Calculate moments.
		(1)		
4.1c	Equal moments	**M1**	1.1a	5th Calculate sums of moments.
	Solve for F	**M1**	1.1b	
	16.8 (N). Accept 17.	**A1ft**	1.1b	
		(3)		
				(7 marks)

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5.3a	 B1 for each correct force with correct label	B4	2.5	3rd Draw force diagrams.
		(4)		
5.3b	Res(→) $F = P\cos 30$	M1	3.1b	5th Calculate resultant forces in perpendicular directions.
	$\frac{\sqrt{3}}{2}P$	A1	1.1b	
	Res(↑) $R = 5g - P\sin 30$	M1	3.1b	
	$5g - \frac{1}{2}P$	A1	1.1b	
		(4)		
5.3c	If $P = 20$, Substitute into R $R = 39$ N	M1 A1	1.1b 1.1b	7th The concept of limiting equilibrium.
	Substitute into F $F = 10\sqrt{3}$ or 17.320… (N)	M1 A1	1.1b 1.1b	
	If limiting equilibrium, $\mu = \frac{F}{R} = \frac{10\sqrt{3}}{39}$ or 0.444… So $\mu \geqslant \frac{10\sqrt{3}}{39}$ or $\mu \geqslant 0.44$	M1 A1ft	3.1b 3.2a	
		(6)		
				(14 marks)

Notes

5.3b
Allow if g explicitly evaluated.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
8.3a	 Diagram of two forces acting on ball. Weight (g) must be downwards and drag (kv) upwards.	B1 B1	2.5 2.5	3rd Draw force diagrams.
		(2)		
8.3b	Solve weight = drag for v	M1	3.1b	6th Work with systems of forces in equilibrium.
	$v = \frac{g}{k}$	A1	1.1b	
		(2)		
8.3c	Use of $F = ma$ with $m = 1$	M1	1.1b	5th Use equations of motion to solve problems in familiar contexts.
	$\frac{\mathrm{d}v}{\mathrm{d}t}$ is acceleration	A1	1.2	
	Total downward force is $g - kv$	A1	3.4	
		(3)		
8.3d	Use of differentiation to evaluate both sides.	M1	2.1	7th Solve general kinematics problems in less familiar contexts.
	$\text{LHS} = \frac{\mathrm{d}v}{\mathrm{d}t} = g\,\mathrm{e}^{-kt}$	A1	2.1	
	$\text{RHS} = g - kv = g - k.\frac{g}{k}\left(1 - \mathrm{e}^{-kt}\right) = g\,\mathrm{e}^{-kt}$	A1	2.1	
		(3)		

8.3e	As $t \to \infty, v \to \frac{g}{k}$, the terminal velocity	**B1**	3.2a	7th Solve general kinematics problems in less familiar contexts.
		(1)		
8.3f	Correct limitation	**B1**	3.5b	3rd Understand assumptions common in mathematical modelling.
		(1)		
				(12 marks)

Notes

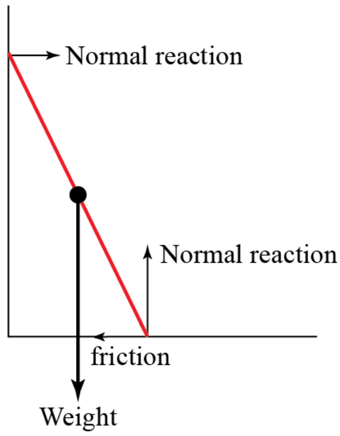
8.3a

B1 for correct weight force labelled.

B1 for correct drag force labelled.

8.3f

For example, upthrust due to water pressure, drag proportional to velocity only at low velocity.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7.1a	**Figure 1**  Force descriptions in words $\times$ 4(one mark each)	**B4**	2.5	3rd Draw force diagrams.
		(4)		
7.1b	Weight force is 9.8 × 6	**M1**	1.1b	7th The concept of limiting equilibrium.
	= 58.8 (N) (Accept awrt 59)	**A1**	1.1b	
	Resolve forces in vertical direction.	**M1**	3.1b	
	Normal reaction on floor is 58.8 (N) (Accept awrt 59)	**A1**	1.1b	
	Take moments about base of ladder.	**M1**	3.1b	
	$58.8 \times 5 \sin 20 = N \times 10 \cos 20$	**M1**	1.1b	
	$N = 10.70\ldots$ (N) (Accept awrt 11)	**A1**	1.1b	
	Resolve forces in horizontal direction.	**M1**	3.1b	
	Friction force on floor is 10.70… (N) (Accept awrt 11)	**A1**	1.1b	
	$\mu R = 0.3 \times 58.8$	**M1**	1.1b	
	= 17.6 (N)	**A1**	1.1b	
	$> F$	**A1**	2.4	
	So does not slip.	**A1**	2.4	
		(13)		
				(17 marks)