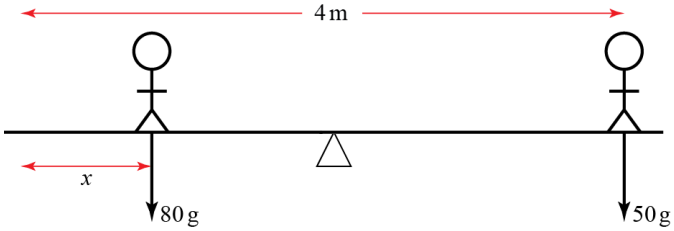
Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1a	Force = 4 × 9.8 = 39.2 (N). Accept 39.	**M1**	1.1b	4th Calculate moments.
	Moment = force × distance	**M1**	1.1a	
	Moment = 39.2 × 3 = 117.6 (N m). Accept 118.	**A1**	1.1b	
		(3)		
1b	Moment = $F \times 7 = 7F$ (N m)	**A1**	1.1b	4th Calculate moments.
		(1)		
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)
Notes				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2a	**Figure 1**  Force labels one mark each Allow explicit evaluation with g.	**B2**	2.5	4th Calculate moments.
		(2)		
2b	Alice: Moment = $2 \times 50 \times g$	**M1**	1.1b	5th Calculate sums of moments.
	= $100g$ (N m)	**A1**	1.1b	
	Bob: Moment = $(2 - x) \times 80 \times g$	**M1**	3.4	
	= $80(2 - x)g$ (N m)	**A1**	1.1b	
	Total clockwise moment = $20g(4x - 3)$ (N m)	**A1**	1.1b	
		(5)		
2c	Equating to 0 and solving	**M1**	3.4	5th Solve equilibrium problems involving horizontal bars.
	$x = 0.75$ (m)	**A1**	1.1b	
		(2)		
2d	Identifying 2 as a limit	**M1**	2.4	7th Solve problems involving bodies on the point of tilting.
	So tilts towards Alice when $0.75 < x \leqslant 2$	**A1**	2.2a	
		(2)		

2e	Any valid limitation. For example, Pivot not a point. Alice can't sit exactly on the end. The see-saw might bend.	**A1**	3.5	3rd Understand assumptions common in mathematical modelling.
		(1)		
				(12 marks)

Notes

2d

Allow any similar valid argument.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	Moment from bus = $5000 \times 2 \times g$	**M1**	3.1a	5th Find resultant moments by considering direction.
	$= 10\,000g$ (N m)	**A1**	1.1b	
	Moment from gold = $1000 \times 12 \times g$	**M1**	3.1b	
	$= 12\,000g$ (N m)	**A1**	1.1b	
	Moment from people = $70 \times 8 \times n \times g$	**M1**	3.1a	
	$= 560ng$ (N m)	**A1**	1.1b	
	Total moment = $(22\,000 - 560n)g$ (N m)	**A1**	1.1b	
		(7)		
3b	Forming an equation or inequality for n and solving to find ($n = 39.28\ldots$)	**M1**	1.1b	5th Solve equilibrium problems involving horizontal bars.
	Need 40 people.	**A1**	3.2a	
		(2)		
3c	New moment from gold and extra person is $1070 \times 12 \times g$ (N)	**M1**	3.1a	5th Solve equilibrium problems involving horizontal bars.
	New total moment = $(22840 - 560n)g$ (N m)	**M1**	1.1b	
	$n = 40.78\ldots$	**A1**	3.2a	
	42 people (including the extra)	**A1**	2.4	
		(4)		
				(13 marks)

Notes

Allow explicit calculations with g evaluated.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4	Weight of right mass is $10g$ (N)	**M1**	1.1b	7th Solve problems involving bodies on the point of tilting.
	Moment on right gear is force × distance from centre	**M1**	3.1b	
	Moment = $10g \times 0.08 = 0.8g$ (N m)	**A1**	1.1b	
	Force on left gear by right gear is $\frac{\text{moment}}{\text{distance}}$	**M1**	3.1b	
	Force on left gear by right is $\frac{0.8g}{0.1} = 8g$	**A1**	1.1b	
	Moment on left gear is force × distance from centre	**M1**	3.1b	
	Moment = $8g \times 0.05 = 0.4g$ (N m)	**A1**	1.1b	
	Weight = $\frac{\text{moment}}{\text{distance}}$	**M1**	1.1a	
	Weight = $\frac{0.4g}{0.02} = 20g$ (N)	**M1**	1.1b	
	$M = 20g \div g = 20$ (kg)	**A1**	1.1b	
				(10 marks)

Notes

Allow calculations with g evaluated.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5	Moment on see-saw is force × distance from pivot.	M1	1.1a	5th Solve equilibrium problems involving horizontal bars.
	Moment on Poppy's see-saw due to Poppy is $pg \times 3 = 3pg$ (N m)	M1	2.2a	
	Force on Bob due to Poppy is $\frac{3pg}{2}$ (N)	A1	2.2a	
	Force on Bob due to Quentin is $\frac{3qg}{2}$ (N)	A1	2.2a	
	Total force on Bob is $\frac{3}{2}(p+q)g$ (N)	M1	2.2a	
	Weight of Bob is $80g$ (N)	M1	1.1b	
	Forces are equal so $\frac{3}{2}(p+q)g = 80g$	M1	3.1b	
	$p + q = 53$ to the nearest whole number.	A1	2.4	
				(8 marks)

Notes

Allow calculations with g evaluated.