|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **1a** | Force = 4 × 9.8 = 39.2 (N). Accept 39. | **M1** | 1.1b | 4thCalculate moments. |
| Moment = force × distance | **M1** | 1.1a |
| Moment = 39.2 × 3 = 117.6 (N m). Accept 118. | **A1** | 1.1b |
|  | **(3)** |  |  |
| **1b** | Moment = *F* × 7 = 7*F* (N m) | **A1** | 1.1b | 4thCalculate moments. |
|  | **(1)** |  |  |
| **1c** | Equal moments | **M1** | 1.1a | 5thCalculate 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 eachAllow explicit evaluation with *g.* | **B2** | 2.5 | 4thCalculate moments. |
|  | **(2)** |  |  |
| **2b** | Alice: Moment = 2 × 50 × *g* | **M1** | 1.1b | 5thCalculate sums of moments. |
| = 100*g* (N m) | **A1** | 1.1b |
| Bob: Moment = (2 − *x*) × 80 × *g* | **M1** | 3.4 |
| = 80(2 − *x*)*g* (N m) | **A1** | 1.1b |
| Total clockwise moment = 20*g*(4*x* − 3) (N m) | **A1** | 1.1b |
|  | **(5)** |  |  |
| **2c** | Equating to 0 and solving | **M1** | 3.4 | 5thSolve equilibrium problems involving horizontal bars. |
| *x* = 0.75 (m) | **A1** | 1.1b |
|  | **(2)** |  |  |
| **2d** | Identifying 2 as a limit | **M1** | 2.4 | 7thSolve problems involving bodies on the point of tilting. |
| So tilts towards Alice when 0.75 < *x* ⩽ 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 | 3rdUnderstand 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 × 2 × *g* | **M1** | 3.1a | 5thFind resultant moments by considering direction. |
| = 10 000*g* (N m) | **A1** | 1.1b |
| Moment from gold = 1000 × 12 × *g* | **M1** | 3.1b |
| = 12 000*g* (N m) | **A1** | 1.1b |
| Moment from people = 70 × 8 × *n* × *g* | **M1** | 3.1a |
| = 560*ng* (N m) | **A1** | 1.1b |
| Total moment = (22 000 − 560*n*)*g* (N m) | **A1** | 1.1b |
|  | **(7)** |  |  |
| **3b** | Forming an equation or inequality for *n* and solving to find (*n* = 39.28…) | **M1** | 1.1b | 5thSolve equilibrium problems involving horizontal bars. |
| Need 40 people. | **A1** | 3.2a |
|  | **(2)** |  |  |
| **3c** | New moment from gold and extra person is 1070 × 12 × *g* (N) | **M1** | 3.1a | 5thSolve equilibrium problems involving horizontal bars. |
| New total moment = (22840 − 560*n*)*g* (N m) | **M1** | 1.1b |
| *n* = 40.78… | **A1** | 3.2a |
| 42 people (including the extra) | **A1** | 2.4 |
|  | **(4)** |  |  |
| (13 marks) |
| NotesAllow explicit calculations with *g* evaluated. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **4** | Weight of right mass is 10*g* (N) | **M1** | 1.1b | 7thSolve problems involving bodies on the point of tilting. |
| Moment on right gear is force × distance from centre | **M1** | 3.1b |
| Moment = 10*g* × 0.08 = 0.8*g* (N m) | **A1** | 1.1b |
| Force on left gear by right gear is | **M1** | 3.1b |
| Force on left gear by right is= 8*g* | **A1** | 1.1b |
| Moment on left gear is force × distance from centre | **M1** | 3.1b |
| Moment = 8*g* × 0.05 = 0.4*g* (N m) | **A1** | 1.1b |
| Weight = | **M1** | 1.1a |
| Weight == 20*g* (N) | **M1** | 1.1b |
| *M* = 20*g* ÷*g* = 20 (kg) | **A1** | 1.1b |
| (10 marks) |
| NotesAllow 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 | 5thSolve equilibrium problems involving horizontal bars. |
| Moment on Poppy’s see-saw due to Poppy is*pg* × 3 = 3*pg* (N m) | **M1** | 2.2a |
| Force on Bob due to Poppy is (N) | **A1** | 2.2a |
| Force on Bob due to Quentin is (N) | **A1** | 2.2a |
| Total force on Bob is (N) | **M1** | 2.2a |
| Weight of Bob is 80*g* (N) | **M1** | 1.1b |
| Forces are equal so = 80*g* | **M1** | 3.1b |
| *p* + *q* = 53 to the nearest whole number. | **A1** | 2.4 |
| (8 marks) |
| NotesAllow calculations with *g* evaluated. |