| Question Number | Scheme | Marks |
|---|---|---|
| **3** | Use of $m\mathbf{v} = \mathbf{I} + m\mathbf{u}$ | M1 |
| | Component of momentum parallel to original direction $= 6\times 0.75 + \sqrt{24}\cos 60 \ \left(= 4.5 + \sqrt{6}\right)$ | A1<br>A1 |
| | Use of Pythagoras: $\left(\frac{3}{4}v =\right)\sqrt{\left(4.5+\sqrt{6}\right)^2 + 18}$ | M1 |
| | $v = 10.9 \ \left(\text{m s}^{-1}\right), 11\left(\text{m s}^{-1}\right)$ | A1 |
| | ***Alternative for the 1st 5 marks:*** | |
| | Vector triangle for impulses or velocities | M1 |
| | Use of cosine rule | M1 |
| | $\left(\frac{3}{4}v\right)^2 = 4.5^2 + 24 - 2\times 4.5\times\sqrt{24}\times\cos 120°$ | A1<br>A1 |
| | $v = 10.9 \ \left(\text{m s}^{-1}\right), 11\left(\text{m s}^{-1}\right)$ | A1 |
| | Change in direction $= \tan^{-1}\dfrac{3\sqrt{2}}{4.5+\sqrt{6}}$ | M1 |
| | $= 31.4° \ (31°)$ | A1 (7) |
| | **Notes** | **[7]** |
| **M1** | Need to consider both components. | |
| **A1** | Or equivalent | |
| **M1** | Or equivalent. | |
| **A1** | Correct LHS | |
| **A1** | Or better | |
| **M1** | Must be using correct triangle - need $120°$ seen or implied | |
| **A1** | Correct unsimplified | |
| **A1** | Or better | |
| **M1** | Or equivalent use of trig. With their components to find **the required angle**<br>Eg angle $= \cos^{-1}\left(\dfrac{4.5^2 + (mv)^2 - 24}{2\times 4.5\times(mv)}\right)$<br>Or from scalar product,<br>$\cos^{-1}\left(\dfrac{6\times 9.27...}{6\times 10.9...}\right)$ | |
| **A1** | 0.548 radians $(0.55 \text{ radians})$<br>or better. Do not ISW | |



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