Oblique collisions of smooth spheres

Answers

Further Maths topic practice

This topic online

Q	Answer	Marks
1	**a)** $5\sqrt{3}/2 = 4.33$ m s^{-1} **b)** 3.31 m s^{-1} at 49.1° to the line of centres	7
2	**a)** A: (0.4i + 3j) m s^{-1}, B: (3.4i + 5j) m s^{-1} **b)** 1.08 N s	7
3	Along the line of centres P is left with no velocity, so P moves perpendicular to the line of centres and Q moves along it: they move at right angles.	5
4	**a)** A: 1 m s^{-1} (direction reversed), B: 2 m s^{-1} (direction reversed, away from A) **b)** $\sqrt{28} = 5.29$ m s^{-1} at 79.1° to the line of centres **c)** 2 J	9
5	**a)** A: 7 m s^{-1}, B: 1 m s^{-1} **b)** A: (3.2i + 2.6j) m s^{-1}, B: (2.6i + 6.8j) m s^{-1}	9
6	**a)** $e = 1/k$ (shown) **b)** $0 < e \leq 1$ and $e = 1/k$, so $k \geq 1$ **c)** 1/4	7
7	**a)** 0.974 m s^{-1} **b)** 88.0°	8
8	**a)** $(0.12i + 0.16j)/0.2 = 0.6i + 0.8j$ (shown) **b)** A: (4.75i - 2j) m s^{-1}, B: (2.25i + 3j) m s^{-1} **c)** 0.75 J	9
9	**a)** $\sqrt{3}u(1 - 3e)/8$ (shown) **b)** $e = 7/9$ (shown) **c)** $2\sqrt{3}u/9$ ($\approx 0.385u$)	9
10	**a)** 2.15 m s^{-1} **b)** 1.06 m s^{-1} **c)** 1.85 m s^{-1} at 26.7° to the cushion	10
11	**a)** (-0.6i + 0.6j) N s **b)** (i + j) m s^{-1} **c)** The spheres are smooth, so the impulse acts along the line of centres, and -0.6i + 0.6j is parallel to i - j **d)** $e = 2/3$ **e)** 0.6 J	10
12	**a)** $\sqrt{3}u(1 + e)/10$ **b)** $\sqrt{3}u(1 - 4e)/10$ (shown) **c)** deflection > 90° $\Leftrightarrow$ $e > 2/3$ (shown) **d)** $21mu^2/160$	12

Full worked solutions, written out by hand, are on the solutions sheet for this topic.

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