Successive collisions

Answers

Further Maths topic practice

This topic online

Q	Answer	Marks
1	**a)** A: 3 m s^{-1}, B: 6 m s^{-1} **b)** 2.4 m s^{-1} **c)** A is still moving towards the wall at 3 m s^{-1} and B is moving towards A, so they must meet	7
2	**a)** A: 1 m s^{-1}, B: 3 m s^{-1} **b)** B: 0.75 m s^{-1}, C: 2.25 m s^{-1} **c)** All move in the same direction and A (1 m s^{-1}) is faster than B (0.75 m s^{-1}), so A catches B	7
3	**a)** 4.5 m s^{-1}; e = 0.5 **b)** 0.4 **c)** P: 0.28 m s^{-1} away from the wall; Q: 1.62 m s^{-1} towards the wall	9
4	**a)** A: 0.5 m s^{-1}, B: 2.5 m s^{-1} (both towards the wall) **b)** A: 1.75 m s^{-1} and B: 0.75 m s^{-1}, both away from the wall **c)** Both move away from the wall, and A, which is further from the wall, is faster than B **d)** 11.625 J (11.6 J)	10
5	**a)** $v_B = \frac{3}{4}u(1 + e)$, $v_A = \frac{1}{4}u(3 - e)$ **b)** $e = \frac{1}{2}$ **c)** A is still moving at $\frac{5}{8}u$ towards B, which is at rest, so they collide (shown)	8
6	**a)** A: 1 m s^{-1}, B: 3 m s^{-1} **b)** 0.48 m **c)** 0.72 s	9
7	**a)** $v_A = \frac{1}{3}u(1 - 2e)$, $v_B = \frac{1}{3}u(1 + e)$ (shown) **b)** Second collision if and only if $0 \leq e < \frac{4}{5}$ (shown)	10
8	**a)** A: 1.5 m s^{-1}, B: 3 m s^{-1} **b)** f = 0.5 **c)** 1.5 m s^{-1} towards the wall; B hits the wall again	8
9	**a)** $v_A = \frac{1}{2}u(1 - e)$, $v_B = \frac{1}{2}u(1 + e)$ **b)** $\frac{1}{6}u(1 + e)(1 - 2e)$ **c)** $v_A - v_B' = \frac{1}{3}u[(e - \frac{1}{2})^2 + \frac{3}{4}] > 0$, so A catches B (shown)	9
10	**a)** P: 1.5 m s^{-1}, Q: 3 m s^{-1} **b)** 1 m s^{-1} **c)** P (1.5 m s^{-1}) is faster than Q and R (1 m s^{-1}); P: 1.05 m s^{-1}, Q and R: 1.3 m s^{-1} **d)** 10 725 J (10.7 kJ)	11

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11	**a)** $v_A = \frac{1}{3}u(1 - 2e)$, $v_B = \frac{1}{3}u(1 + e)$ **b)** $\frac{1}{9}u(1 + e)(1 - 2e)$ **c)** $v_A - v_B' = \frac{1}{9}u(1 - 2e)(2 - e) > 0$ if and only if $e < \frac{1}{2}$ (shown) **d)** A and B are both at rest; only C moves on	10
12	**a)** $v_A = \frac{u(2 - k)}{2(1 + k)}$, $v_B = \frac{3u}{2(1 + k)}$ (shown) **b)** $0 < k < \frac{7}{2}$ **c)** A: $\frac{25}{128}u$, B: $\frac{21}{128}u$, both moving away from the wall; A is ahead and faster, so no more collisions	12

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

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