Impulse and Momentum – 2022 GCE AS Mechanics Further Mathematics A

1. June/2022/Paper_Y533/01/No.1

Two stones, A and B, are sliding along the same straight line on a horizontal sheet of ice. Stone A, of mass 50 kg, is moving with a constant velocity of $2.1\,\text{ms}^{-1}$ towards stone B. Stone B, of mass 70 kg, is moving with a constant velocity of $0.8\,\text{ms}^{-1}$ towards stone A.

A and B collide directly. Immediately after their collision stone A's velocity is $0.35\,\text{ms}^{-1}$ in the same direction as its velocity before the collision.

(a) Find the speed of stone B immediately after the collision. **[2]**

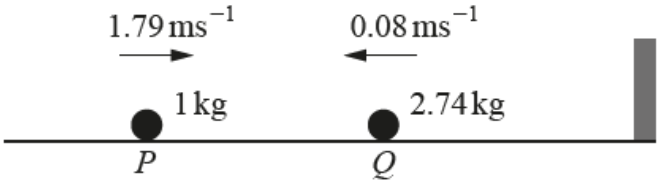
(b) Find the coefficient of restitution for the collision. **[2]**

(c) Find the total loss of kinetic energy caused by the collision. **[3]**

(d) Explain whether the collision was perfectly elastic. **[1]**

2. June/2022/Paper_Y533/01/No.7

Two particles, P and Q, are on a smooth horizontal floor. P, of mass 1 kg, is moving with speed $1.79\,\text{ms}^{-1}$ directly towards a vertical wall. Q, of mass 2.74 kg, is between P and the wall, moving directly towards P with speed $0.08\,\text{ms}^{-1}$ (see diagram).



P and Q collide directly and the coefficient of restitution for this collision is denoted by e.

(a) Show that after this collision the speed of Q is given by $0.42 + 0.5e\,\text{ms}^{-1}$. **[5]**

After this collision, Q then goes on to collide directly with the wall. The coefficient of restitution for the collision between Q and the wall is also e. There is then no subsequent collision between P and Q.

(b) Determine the range of possible values of e. **[7]**