

Exercise 7B

Q. 1. (i)

Before	(Mass)	After
$6\vec{i}$	2	$p\vec{i}$
$4\vec{i}$	1	$q\vec{i}$

$$2(6) + 1(4) = 2(p) + 1(q)$$

$$\Rightarrow 2p + q = 16 \dots \text{Equation 1}$$

$$\frac{p - q}{6 - 4} = -\frac{1}{2}$$

$$\Rightarrow 2p - 2q = -2$$

$$\Rightarrow p - q = -1 \dots \text{Equation 2}$$

Adding equations 1 and 2 we get:

$$3p = 15$$

$$\Rightarrow p = 5 \Rightarrow q = 6$$

\Rightarrow Velocity of 2 kg sphere after impact is $5\vec{i}$ m/s

Velocity of 1 kg sphere after impact is $6\vec{i}$ m/s

(ii)
$$\text{K.E.}_{\text{before}} = \frac{1}{2}(2)(6)^2 + \frac{1}{2}(1)(4)^2$$

$$= 44 \text{ J}$$

$$\text{K.E.}_{\text{after}} = \frac{1}{2}(2)(5)^2 + \frac{1}{2}(1)(6)^2$$

$$= 43 \text{ J}$$

$$\text{Loss} = 44 - 43$$

$$= 1 \text{ J}$$

Q. 2. (i)

Before	(Mass)	After
$2\vec{i}$	1	$p\vec{i}$
$-6\vec{i}$	1	$q\vec{i}$

$$1(2) + 1(-6) = 1(p) + 1(q)$$

$$\Rightarrow p + q = -4 \dots \text{Equation 1}$$

$$\frac{p - q}{2 + 6} = -\frac{3}{4}$$

$$\Rightarrow 4p - 4q = -24$$

$$\Rightarrow p - q = -6 \dots \text{Equation 2}$$

Adding equations 1 and 2 we get

$$2p = -10$$

$$\Rightarrow p = -5$$

$$\Rightarrow q = 1$$

\Rightarrow velocities after impact are $-5\vec{i}$ m/s and \vec{i} m/s

\Rightarrow speeds after impact are 5 m/s and 1 m/s

(ii)
$$\vec{I} = M\vec{v} - M\vec{u}$$

$$= 1(-5\vec{i}) - 1(2\vec{i})$$

$$= -7\vec{i} \text{ Ns} \dots \text{impulse imparted to first sphere}$$

\Rightarrow Impulse imparted to second sphere = $7\vec{i}$ Ns

\Rightarrow Magnitude of impulse imparted to each sphere = 7 Ns.

(iii)
$$\text{K.E.}_{\text{before}} = \frac{1}{2}(1)(2)^2 + \frac{1}{2}(1)(-6)^2$$

$$= 20 \text{ J}$$

$$\text{K.E.}_{\text{after}} = \frac{1}{2}(1)(-5)^2 + \frac{1}{2}(1)(1)^2$$

$$= 13 \text{ J}$$

$$\Rightarrow \text{Loss} = 20 - 13$$

$$\Rightarrow = 7 \text{ J}$$

$$\Rightarrow \% \text{ Loss} = \frac{7}{20} \times 100 = 35\%$$

Q. 3. (i)

Before	(Mass)	After
$10\vec{i}$	3	$0\vec{i}$
\vec{i}	5	$q\vec{i}$

$$3(10) + 5(1) = 3(0) + 5(q)$$

$$\Rightarrow q = 7$$

$$\frac{0 - q}{10 - 1} = -e$$

$$\Rightarrow e = \frac{q}{9} = \frac{7}{9}$$

(ii) 7 m/s

(iii)
$$\vec{I}_1 = M\vec{v}_1 - M\vec{u}_1$$

$$= 3(0\vec{i}) - 3(10\vec{i})$$

$$= -30\vec{i} \text{ Ns}$$

$$\vec{I}_2 = M\vec{v}_2 - M\vec{u}_2$$

$$= 5(7\vec{i}) - 5(\vec{i}) = 30\vec{i} \text{ Ns}$$

(iv) $u = 7, v = 0, s = 2, a = ?$

$$v^2 = u^2 + 2as$$

$$\Rightarrow 0 = 49 + 2a(2)$$

$$\Rightarrow a = \frac{-49}{4} = -12.25 \text{ m/s}^2$$

\therefore Deceleration = -12.25 m/s^2