Q. 4. (i)

Before	(Mass)	After
5	2	v
0	1	$3v$

$2(5) + 1(0) = 2(v) + 1(3v)$

$\Rightarrow 5v = 10 \Rightarrow v = 2$

(ii) $\dfrac{v - 3v}{5 - 0} = -e$

$\Rightarrow \dfrac{-4}{5} = -e \Rightarrow e = \dfrac{4}{5}$

(iii) $\text{K.E.}_{\text{before}} = \dfrac{1}{2}(2)(5)^2 + \dfrac{1}{2}(1)(0)^2$

$= 25$ J

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

$= 22$ J

Loss $= 25 - 22 = 3$ J

% Loss $= \dfrac{3}{25} \times 100 = 12\%$

Q. 5. (i)

Before	(Mass)	After
$6\vec{i}$	5	$p\vec{i}$
$-4\vec{i}$	3	$q\vec{i}$

$5(6) + 3(-4) = 5p + 3q$

$\Rightarrow 5p + 3q = 18$

$\dfrac{p - q}{6 + 4} = -\dfrac{1}{3}$

$\Rightarrow 3p - 3q = -10$

Solving these gives $p = 1$, $q = \dfrac{13}{3}$.

(ii) Loss $= \dfrac{1}{2}Mu^2 - \dfrac{1}{2}Mv^2$

$= \dfrac{1}{2}(5)(6)^2 - \dfrac{1}{2}(5)(1)^2$

$= 87\dfrac{1}{2}$ J

(iii) $M\vec{v} - M\vec{u} = 3\left(\dfrac{13}{3}\vec{i}\right) - 3(-4\vec{i})$

$= 25\vec{i}$ Ns

Q. 6. (i)

Before	(Mass)	After
$10\vec{i}$	2	$p\vec{i}$
$0\vec{i}$	3	$q\vec{i}$

$2(10) + 3(0) = 2p + 3q$

$\Rightarrow 2p + 3q = 20$

$\dfrac{p - q}{10 - 0} = -\dfrac{1}{2}$

$\Rightarrow p - q = -5$

Solving these gives $p = 1$, $q = 6$.

Answer: 1 m/s and 6 m/s.

(ii) $\text{K.E.}_{\text{Before}} = \dfrac{1}{2}(2)(10)^2 + \dfrac{1}{2}(3)(0)^2$

$= 100$ J

$\text{K.E.}_{\text{After}} = \dfrac{1}{2}(2)(1)^2 + \dfrac{1}{2}(3)(6)^2$

$= 55$ J

Loss $= 100 - 55 = 45$ J

(iii) To find the acceleration:

$v = u + at$

$\Rightarrow 0 = 6 + a(2)$

$\Rightarrow a = -3$

To find the force:

$F = Ma$

$\Rightarrow F = (3)(-3) = -9$ N

(i.e. it is a resistance force of 9 N)

To find the distance:

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

$\Rightarrow 0 = (6)^2 + 2(-3)s$

$\Rightarrow s = 6$ m

To find work done:

$W = Fs = 9(6) = 54$ J

To find power:

$\text{Power} = \dfrac{\text{Work}}{\text{Time}}$

$= \dfrac{54}{2} = 27$ W

Q. 7. (i)

	Before	(Mass)	After
A:	$4\vec{i}$	M	$p\vec{i}$
B:	$0\vec{i}$	M	$q\vec{i}$

$M(4) + M(0) = Mp + Mq$

$\Rightarrow p + q = 4$

$\dfrac{p - q}{4 - 0} = -\dfrac{1}{2}$

$\Rightarrow p - q = -2$

Solving these gives $p = 1$, $q = 3$.

Speed of B is 3 m/s.