3 **(a)** State Newton's third law of motion.

.....

.....

..... [2]

(b) A block X of mass m_X slides in a straight line along a horizontal frictionless surface, as shown in Fig. 3.1.

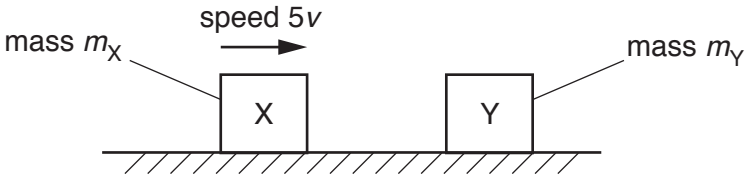

Fig. 3.1

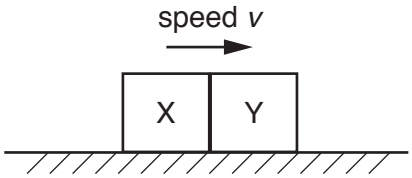

Fig. 3.2

The block X, moving with speed $5v$, collides head-on with a stationary block Y of mass m_Y. The two blocks stick together and then move with common speed v, as shown in Fig. 3.2.

(i) Use conservation of momentum to show that the ratio $\frac{m_Y}{m_x}$ is equal to 4.

[2]

(ii) Calculate the ratio

$$\frac{\text{total kinetic energy of X and Y after collision}}{\text{total kinetic energy of X and Y before collision}}.$$

ratio = ... [3]

(iii) State the value of the ratio in **(ii)** for a perfectly elastic collision.

ratio = ... [1]

(c) The variation with time t of the momentum of block X in **(b)** is shown in Fig. 3.3.

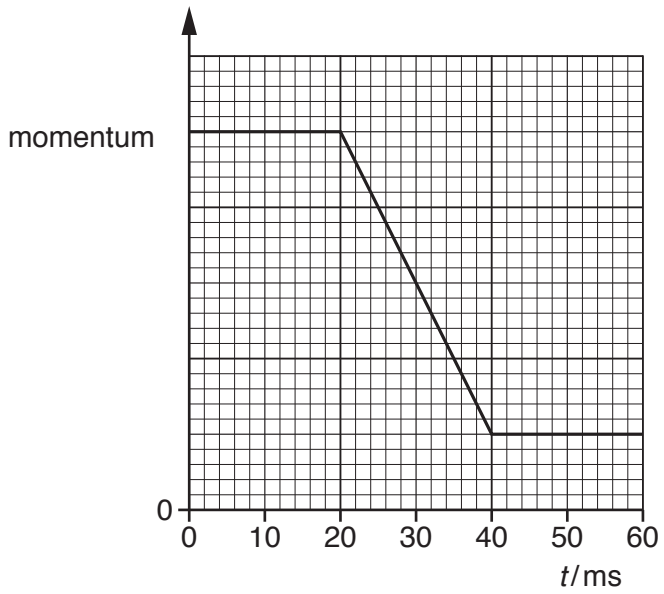

Fig. 3.3

Block X makes contact with block Y at time $t = 20$ ms.

(i) Describe, qualitatively, the magnitude and direction of the resultant force, if any, acting on block X in the time interval:

1. $t = 0$ to $t = 20$ ms

.....

2. $t = 20$ ms to $t = 40$ ms.

.....

.....

[3]

(ii) On Fig. 3.3, sketch the variation of the momentum of block Y with time t from $t = 0$ to $t = 60$ ms. [3]

[Total: 14]

[Turn over