

- 3 (a) State the principle of conservation of momentum.

.....  
.....  
..... [2]

- (b) A firework is initially stationary. It explodes into three fragments A, B and C that move in a horizontal plane, as shown in the view from above in Fig. 3.1.

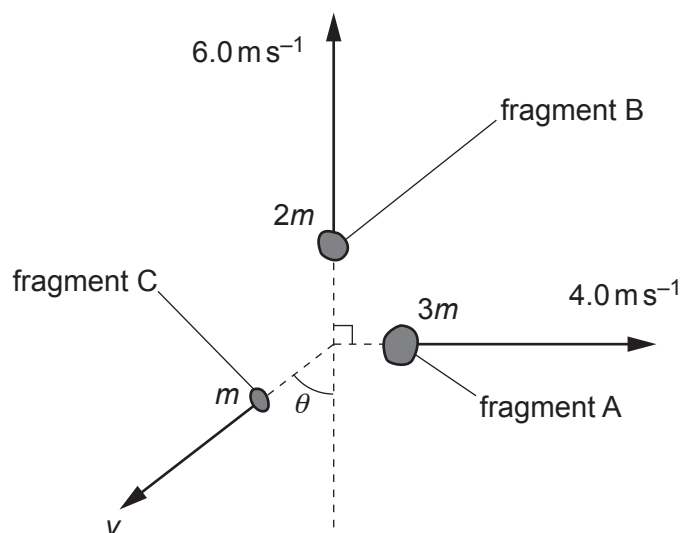


Fig. 3.1

Fragment A has a mass of  $3m$  and moves away from the explosion at a speed of  $4.0 \text{ ms}^{-1}$ .

Fragment B has a mass of  $2m$  and moves away from the explosion at a speed of  $6.0 \text{ ms}^{-1}$  at right angles to the direction of A.

Fragment C has a mass of  $m$  and moves away from the explosion at a speed  $v$  and at an angle  $\theta$  as shown in Fig. 3.1.

Calculate:

- (i) the angle  $\theta$

$\theta = \dots\dots\dots^\circ$  [3]

(ii) the speed  $v$ .

$v = \dots\dots\dots \text{ms}^{-1}$  [2]

(c) The firework in (b) contains a chemical that has mass 5.0 g and has chemical energy per unit mass  $700 \text{ J kg}^{-1}$ . When the firework explodes, all of the chemical energy is transferred to the kinetic energy of fragments A, B and C.

(i) Show that the total chemical energy in the firework is 3.5 J.

[1]

(ii) Calculate the mass  $m$ .

$m = \dots\dots\dots \text{kg}$  [3]

[Total: 11]