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.

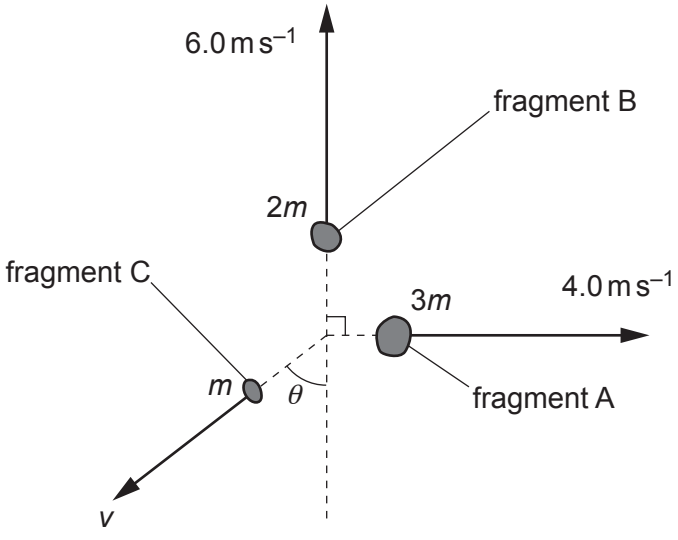

Fig. 3.1

Fragment A has a mass of 3*m* and moves away from the explosion at a speed of 4.0 m s^{-1}.

Fragment B has a mass of 2*m* and moves away from the explosion at a speed of 6.0 m s^{-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 θ as shown in Fig. 3.1.

Calculate:

(i) the angle θ

θ = ...° [3]

(ii) the speed v.

v = ... $m\,s^{-1}$ [2]

(c) The firework in **(b)** contains a chemical that has mass 5.0 g and has chemical energy per unit mass $700\,J\,kg^{-1}$. 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 = ... kg [3]

[Total: 11]