1 **(a)** Fig 1.1 shows two frictionless trolleys A and B of mass m_A and m_B moving horizontally towards a wall with the same speed u. The trolleys are not in contact.

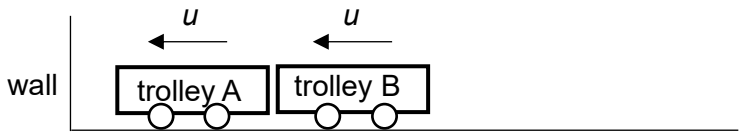

Fig. 1.1

Upon collision with the wall, trolley A rebounds with speed u and collides elastically with trolley B.

(i) State the principle of conservation of momentum.

.....

.....

.....

.....

[2]

(ii) Taking motion to the right as positive, show that the speed of trolley B, v_B after the collision with trolley A is given by the expression

$$v_B = \frac{3m_A - m_B}{m_A + m_B} u \,.$$

[3]

(b) A student performs a similar experiment with a basketball of mass 0.62 kg and a tennis ball of mass 0.059 kg. The student places the tennis ball slightly above the basketball and releases both at the same time from a height above the ground, as shown in Fig. 1.2.

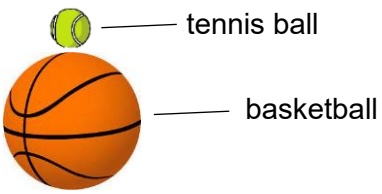

Fig. 1.2

Just before the basketball touches the ground, both the basketball and the tennis ball have the same speed of 4.4 m s^{-1}. The basketball bounces off the ground with a speed of 4.4 m s^{-1}. Its subsequent impact with the tennis ball causes the tennis ball to move up at a very large speed.

(i) Using the expression in **(a)(ii)**, determine the speed of the tennis ball after its collision with the basketball.

speed = ... m s^{-1} [1]

(ii) Besides the assumptions that all collisions are elastic and air resistance is negligible, state one other assumption that is necessary in order to use the result in **(a)(ii)** to determine the speed for **(b)(i)**.

.....

[1]

(iii) The student repeats the experiment, replacing the tennis ball with another ball of much smaller mass.

Deduce the maximum speed the ball can have after its collision with the basketball.

maximum speed = ... $m\ s^{-1}$ [2]