

- 8 Ball A is dropped from rest from a height of 1.20 m above horizontal ground.

Ball B is projected from the same height above horizontal ground with horizontal velocity  $3.60 \text{ ms}^{-1}$ .

Both balls have mass 57.0 g.

Air resistance is negligible.

- (a) Explain the order in which the balls hit the ground.

.....  
.....  
.....

[2]

- (b) (i) Calculate the velocity at which ball A hits the ground.

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

- (ii) Ball A bounces back to a maximum height of 0.95 m.

Calculate the thermal energy transferred to the ball and surroundings.

$$\text{thermal energy} = \dots \text{ J} [2]$$

- (iii) The proportion of energy transferred thermally on each bounce is constant.

Calculate the minimum number of bounces that are required for the maximum height to decrease from 1.20 m to below 0.35 m.

$$\text{number of bounces} = \dots [3]$$





- (c) Ball B lands on a small sand pit on an initially stationary trolley. This sets the trolley in motion along the horizontal ground. Ball B is then stationary with respect to the trolley.
- (i) State the horizontal and vertical components of the velocity of ball B just before it impacts with the trolley. Assume the trolley is at ground level.

horizontal component of velocity = .....  $\text{ms}^{-1}$

vertical component of velocity = .....  $\text{ms}^{-1}$   
[2]

- (ii) The mass of the trolley and sand is 154 g.

Calculate the velocity of the trolley immediately after ball B has landed on it.

velocity = .....  $\text{ms}^{-1}$  [3]

- (iii) The trolley in (c) gradually slows down.

Suggest an explanation for this.

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





(d) When travelling at  $0.25\text{ ms}^{-1}$ , the trolley in (c), carrying the ball B, collides with a wall. The wall exerts a force on the trolley.

- (i) Suggest how the magnitude of this force could be reduced.

[2]

[2]

- (ii) The average force exerted by the wall on the trolley is 0.65N.

Calculate the time taken for the trolley to come to a stop.

time = ..... s [2]

[Total: 20]

