# Mechanics 2 Work, Energy, Power

1   A stone, of mass $0.4\,\text{kg}$, is thrown vertically upwards with a speed of $8\,\text{m s}^{-1}$ from a point at a height of 6 metres above ground level.

   (a)   Calculate the initial kinetic energy of the stone.   *(2 marks)*

   (b)   (i)   Show that the kinetic energy of the stone when it hits the ground is 36.3 J, correct to three significant figures.   *(2 marks)*

         (ii)   Hence find the speed at which the stone hits the ground.   *(3 marks)*

         (iii)   State one assumption that you have made.   *(1 mark)*

2   A ball of mass $0.6\,\text{kg}$ is thrown vertically upwards from ground level with an initial speed of $14\,\text{m s}^{-1}$.

   (a)   Calculate the initial kinetic energy of the ball.   *(2 marks)*

   (b)   Assuming that no resistance forces act on the ball, use an energy method to find the maximum height reached by the ball.   *(3 marks)*

   (c)   An experiment is conducted to confirm the maximum height for the ball calculated in part (b). In this experiment the ball rises to a height of only 8 metres.

         (i)   Find the work done against the air resistance force that acts on the ball as it moves.   *(3 marks)*

         (ii)   Assuming that the air resistance force is constant, find its magnitude.   *(2 marks)*

   (d)   Explain why it is **not** realistic to model the air resistance as a constant force.   *(1 mark)*

1 A child, of mass 35 kg, slides down a slide in a water park. The child, starting from rest, slides from the point A to the point B, which is 10 metres vertically below the level of A, as shown in the diagram.
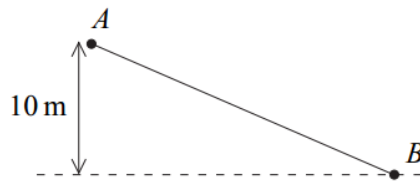
(a) In a simple model, all resistance forces are ignored.

Use an energy method to find the speed of the child at B. *(3 marks)*

(b) State one resistance force that has been ignored in answering part (a). *(1 mark)*

(c) In fact, when the child slides down the slide, she reaches B with a speed of $12 \, \text{m s}^{-1}$.

Given that the slide is 20 metres long and the sum of the resistance forces has a constant magnitude of F newtons, use an energy method to find the value of F.

(4 marks)

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1 A hot air balloon moves vertically upwards with a constant velocity. When the balloon is at a height of 30 metres above ground level, a box of mass 5 kg is released from the balloon.

After the box is released, it initially moves vertically upwards with speed $10 \, \text{m s}^{-1}$.

(a) Find the initial kinetic energy of the box. *(2 marks)*

(b) Show that the kinetic energy of the box when it hits the ground is 1720 J. *(3 marks)*

(c) Hence find the speed of the box when it hits the ground. *(3 marks)*

(d) State **two** modelling assumptions which you have made. *(2 marks)*