Relative Motion 5.1

A Level P P P

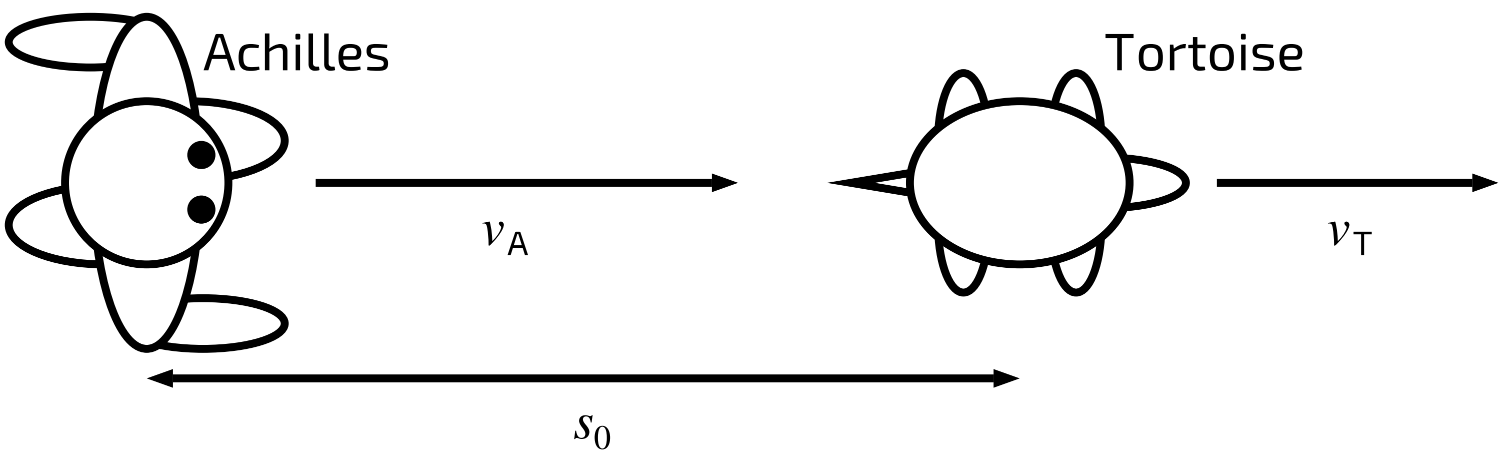

Figure 1: Achilles chasing the tortoise.

Quantities:

v_A velocity of Achilles $(\mathrm{m\,s^{-1}})$
v_T velocity of tortoise $(\mathrm{m\,s^{-1}})$
T time for Achilles to catch up (s)

s_0 initial displacement (m)
s displacement (m)
t time since start (s)

Equations:

$$v = \frac{s}{t}$$

Use the equations above to derive expressions for:

Part A The velocity of Achilles relative to the tortoise

the velocity of Achilles relative to the tortoise v_{REL}.

The following symbols may be useful: `T, s, s_0, t, v_A, v_REL, v_T`

Part B The time for Achilles to catch up

the time for Achilles to catch up with the tortoise T, in terms of v_{A} and v_{T}.

The following symbols may be useful: `T, s, s_0, t, v_A, v_REL, v_T`

Part C The displacement of the tortoise relative to Achilles

the displacement of the tortoise s relative to Achilles as a function of time t.

The following symbols may be useful: `T, s, s_0, t, v_A, v_REL, v_T` isaac Physics. You work it out.

Relative Motion 5.3

A Level

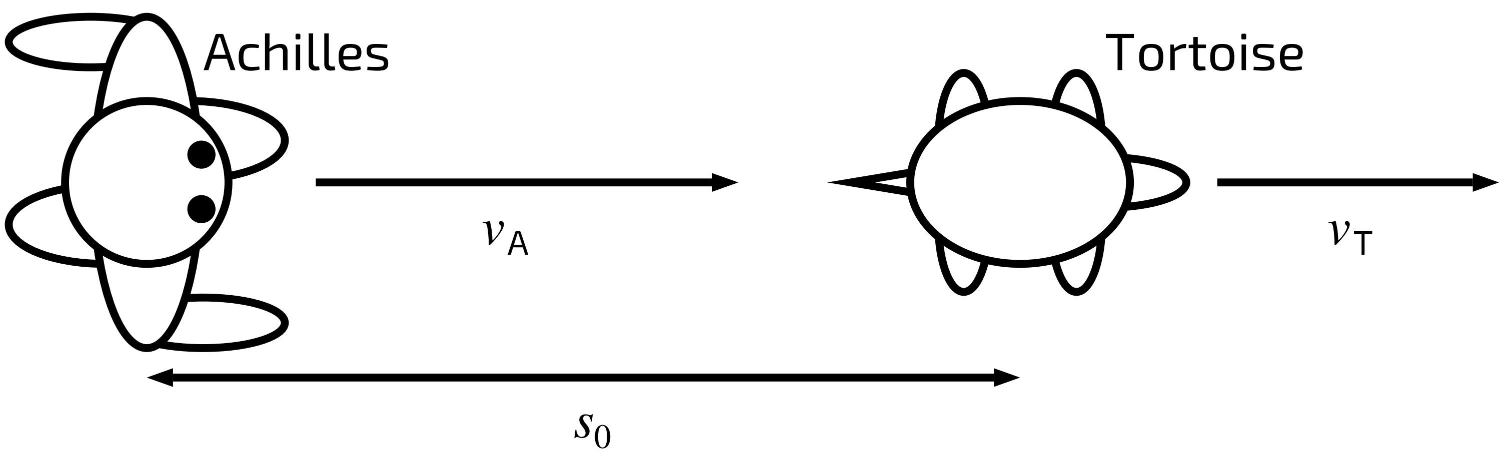

Figure 1: Achilles chasing the tortoise.

Following on from Example 1, when the tortoise travelling at $18.0\,\mathrm{m\,s^{-1}}$ is $1.00\,\mathrm{km}$ away from Achilles, Achilles gets into a motor vehicle that can travel at $96.5\,\mathrm{km\,h^{-1}}$. Calculate how far ahead of the tortoise Achilles is after $2\,\mathrm{minutes}$.

Gameboard:
STEM SMART Physics 26 - Collisions

Essential Pre-Uni Physics F2.5

GCSE A Level

A rocket (containing a space probe) is travelling at $7000\,\mathrm{m\,s^{-1}}$ in outer space. The $2000\,\mathrm{kg}$ probe is ejected from the front of the rocket (forwards) using a big spring. If the speed of the probe afterwards is $7200\,\mathrm{m\,s^{-1}}$, and the rest of the rocket has a mass of $6000\,\mathrm{kg}$, what is the speed of the rest of the rocket? Give your answer to 4 significant figures.

Gameboard:

STEM SMART Physics 26 - Collisions

Physics. You work it out.

Home Physics Mechanics Dynamics Elastic Collisions 1

Elastic Collisions 1

A Level
P P P

Linking Concepts in Pre-Uni Physics 4.1

This question has been amended and may differ from the version you have in your book (if you are using a printed book). The original question can be found by clicking here.

Figure 1: Definitions of variables used in elastic collisions questions

Quantities:

p, P momentum ($\mathrm{kg\,m\,s^{-1}}$)
v, V velocity ($\mathrm{m\,s^{-1}}$)
k, K kinetic energy (J)
m, M mass (kg)

Equations:

$$p = mv \qquad k = \frac{1}{2}mv^2 \qquad P = MV \qquad K = \frac{1}{2}MV^2$$

$$p_0 + P_0 = p_1 + P_1 \qquad k_0 + K_0 = k_1 + K_1$$

Use the equations above to derive expressions for:

Part A Final velocity V_1 of M

the final velocity V_1 of M if M was stationary at the beginning and the initial and final velocities of m (v_0 and v_1) are known.

The following symbols may be useful: `M, V_1, m, v_0, v_1`

Part B V_1 with equal masses and m stopped

V_1 if the masses are equal $(M = m)$, M begins at rest $(V_0 = 0)$, m is stopped by the collision $(v_1 = 0)$ and v_0 is known.

The following symbols may be useful: `M, V_0, V_1, m, v_0, v_1`

Part C Separation speed in terms of approach speed

the separation speed $V_1 - v_1$ in terms of the approach speed $v_0 - V_0$.

Hint: Start by writing out $k_0 - k_1 = K_1 - K_0$ in terms of m, M, v_0, v_1, V_0 and V_1. Factorise your expression, then simplify it remembering that $p_0 - p_1 = P_1 - P_0$.

The following symbols may be useful: `V_0, V_1, v_0, v_1`

Physics. You work it out.

Home Gameboard Physics Mechanics Dynamics Elastic Collisions 4.6

Elastic Collisions 4.6

A Level

In space, an elastic 'sling shot' collision is arranged between a $6.4 \times 10^{24}\,\mathrm{kg}$ planet moving at $9.0\,\mathrm{km\,s^{-1}}$ towards a $6000\,\mathrm{kg}$ spacecraft which is also moving at $4.5\,\mathrm{km\,s^{-1}}$ towards the planet.

Calculate the final speed of the spacecraft.

Gameboard:

STEM SMART Physics 26 - Collisions

Physics. You work it out.

Elastic Collisions 4.7

A Level

A neutron (of mass m) travelling at $2.4 \times 10^5\,\mathrm{m\,s^{-1}}$ collides elastically with a stationary carbon nucleus (mass $M = 12m$) head on. Calculate,

Part A The final speed of the nucleus

Calculate the final speed of the carbon nucleus.

Part B The percentage of the KE given to the nucleus

Calculate the percentage of the neutron's kinetic energy which is given to the nucleus.

Gameboard:

STEM SMART Physics 26 - Collisions

Physics. You work it out.

Elastic Collisions 4.8

A Level
P P P

A neutron (of mass m) travelling at $2.4 \times 10^5\,\mathrm{m\,s^{-1}}$ collides elastically with a stationary iron nucleus (mass $M = 65m$) head on. Calculate,

Part A The final speed of the nucleus

Calculate the final speed of the iron nucleus.

Part B The percentage of the energy given to the nucleus

Calculate the percentage of the neutron's kinetic energy which is given to the nucleus.

Gameboard:
STEM SMART Physics 26 - Collisions