Momentum and Kinetic Energy 3.11

A Level

A $10\,\mathrm{MeV}$ particle in a particle detector travels on a curved path in a magnetic field. Its charge is $1.60 \times 10^{-19}\,\mathrm{C}$. From the curvature, the momentum of the particle is calculated to be $7.31 \times 10^{-20}\,\mathrm{kg\,m\,s^{-1}}$.

Part A What is the mass of the particle?

What is the mass of the particle?

Part B What is the particle?

What is the particle?

- Proton
- Alpha particle
- Electron
- Positron
- Neutron

Gameboard:

STEM SMART Physics 25 - Momentum

Momentum and Kinetic Energy 3.12

A Level

C C C

A $15\,\mathrm{g}$ bullet hits and stops within a $1.500\,\mathrm{kg}$ sandbag, which then swings up by a height of $5.1\,\mathrm{cm}$. Work out the initial speed of the bullet.

Gameboard:

STEM SMART Physics 25 - Momentum

Launching a Rocket

A Level

C C C

A rocket with initial mass M_0 and exhaust speed v is sitting on its launch pad. Its engines eject mass at a constant rate of magnitude $\left|\frac{\mathrm{d}M}{\mathrm{d}t}\right| = \mu$.

Part A Initial acceleration

What is the initial acceleration, a_0?

The following symbols may be useful: `M_0, a_0, g, mu, v`

Part B Rate of mass ejection

Given that $M_0 = 1.00 \times 10^6\,\mathrm{kg}$, $v = 2000\,\mathrm{m\,s^{-1}}$ and we require $a_0 = 0.500\,\mathrm{m\,s^{-2}}$, what must μ be?

Adapted with permission from HE+.

Gameboard:

STEM SMART Physics 25 - Momentum

A Firework

A Level

C C C

A firework consists of a stack of five parts, each of mass m. It is launched upwards from the ground by a small explosive charge that releases energy E. When the firework reaches its greatest height, another charge releases energy E and causes the bottom part to separate from the other four parts and fall down, while the remaining four parts are propelled upwards. When the remaining four parts reach their maximum height, another charge releases energy E and causes the bottom part to separate from the other three parts. The firework continues to separate in this way until the topmost part is travelling alone (**Figure 1**). The topmost part finally self-destructs in a flash of light when it reaches its maximum height, h.

You may assume that all the energy from the charges is converted into kinetic energy, the explosions do not change the mass of the parts, and the firework is small compared to all the heights involved.

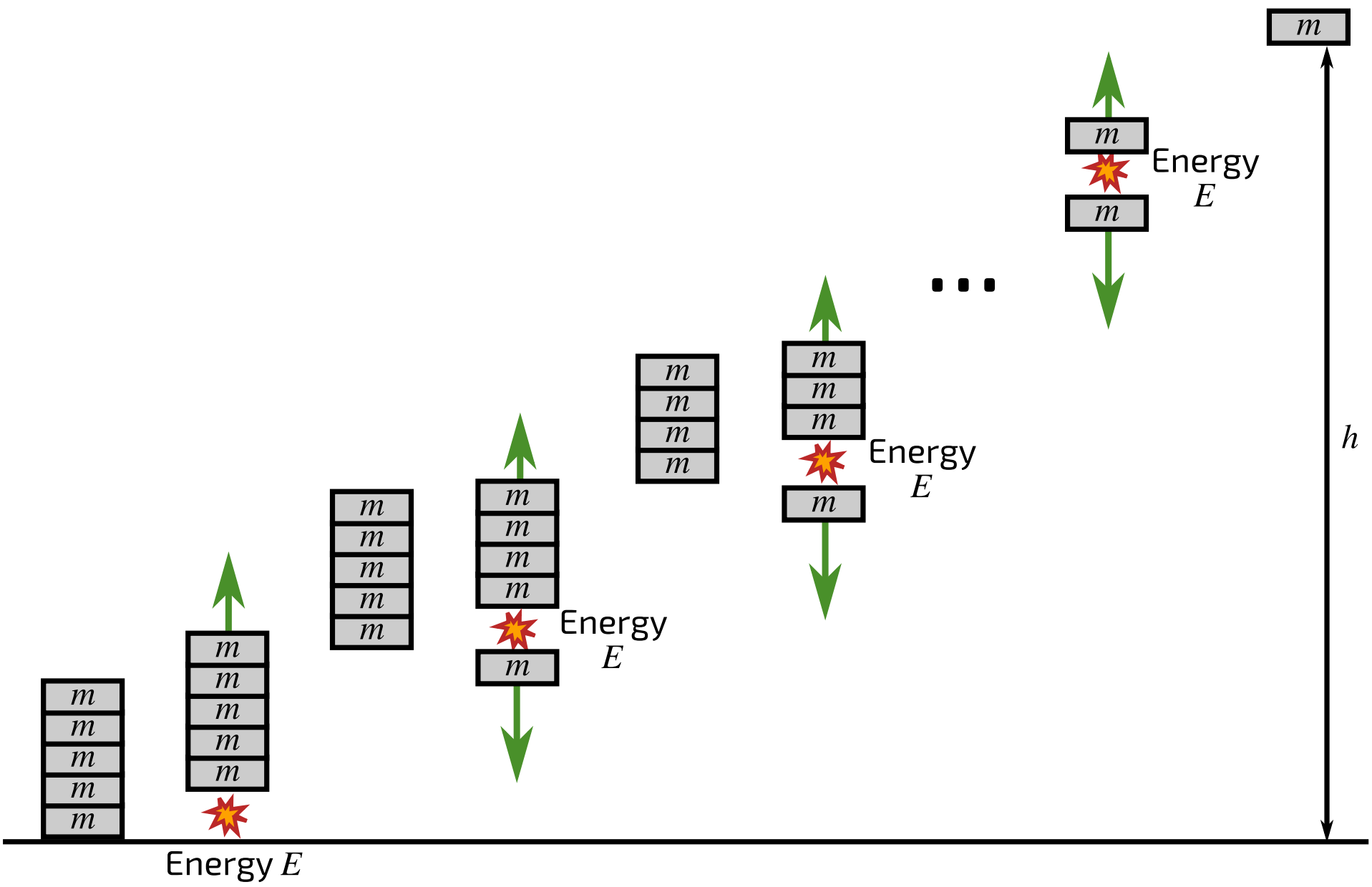

Figure 1: Several stages in the firework separation process.

Find an expression for the final height of the topmost part h, in terms of the energy E of each explosive charge, the mass m of each part, and the gravitational field strength g.

The following symbols may be useful: `E, g, h, m`

Created for isaacphysics.org by Lee Phillips.

Gameboard:

STEM SMART Physics 25 - Momentum

A Ballistic Pendulum

A Level

C C C

A block of wood with a mass of $M = 2.5\,\mathrm{kg}$ is suspended from fixed pegs by vertical strings $l = 3.0\,\mathrm{m}$ long, in a set up known as a ballistic pendulum. A bullet with a mass of $m = 10\,\mathrm{g}$ and moving horizontally with a velocity $u = 300\,\mathrm{m\,s^{-1}}$ enters and remains in the block.

Find the maximum angle θ to the vertical through which the block swings.

Essential Pre-Uni Physics F1.3

GCSE P P P A Level P P P

Please give your answer to the lowest number of significant figures given in the question. You will not get the mark unless the correct unit is given. In this question, ignore the effects of friction & drag.

If a $20000\,\mathrm{kg}$ bus accelerates from $10\,\mathrm{m\,s^{-1}}$ to $25\,\mathrm{m\,s^{-1}}$, what is the change in momentum?

Essential Pre-Uni Physics F1.4

GCSE C C C A Level P P P

Please give your answer to the lowest number of significant figures given in the question. You will not get the mark unless the correct unit is given. In this question, ignore the effects of friction & drag.

A $50\,\mathrm{g}$ ball is travelling at $2.0\,\mathrm{m\,s^{-1}}$ when it hits a wall and rebounds at $1.5\,\mathrm{m\,s^{-1}}$. Calculate the magnitude of the change in momentum.

Gameboard:

STEM SMART Physics 25 - Momentum

Essential Pre-Uni Physics F1.6

GCSE P P P A Level P P P

Please give your answer to the lowest number of significant figures given in the question. You will not get the mark unless the correct unit is given. In this question, ignore the effects of friction & drag.

A $70\,\mathrm{kg}$ person jumps in the air and is travelling downwards at $2.0\,\mathrm{m\,s^{-1}}$ when their feet touch the ground. If it takes the person $0.30\,\mathrm{s}$ to stop, calculate the constant resultant force on them.

Gameboard:

STEM SMART Physics 25 - Momentum

Essential Pre-Uni Physics F2.2

GCSE C C C A Level P P P

Charlie is driving her $20\,000\,\mathrm{kg}$ bus. She stops at a roundabout. Percy is driving his $750\,\mathrm{kg}$ Corsa at $15\,\mathrm{m\,s^{-1}}$ behind her. He fails to stop and rams into the back of the bus, sticking to it. The impact releases the brakes on the bus. How fast will the combined vehicle be travelling immediately after the collision? Give your answer to 2 significant figures.

Gameboard:

STEM SMART Physics 25 - Momentum

Physics. You work it out.

Essential Pre-Uni Physics F2.3

GCSE C C C A Level P P P

A neutron (mass $= 1\,\mathrm{u}$) is moving at $300\,\mathrm{m\,s^{-1}}$ when it smacks into a stationary $^{235}\mathrm{U}$ nucleus (mass $= 235\,\mathrm{u}$), and sticks to it. What will the velocity of the combined particle be? Give your answer to 3 significant figures.

Gameboard:
STEM SMART Physics 25 - Momentum