# 10 Linear Momentum

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## Question box 10.1

**F1** Fireworks in space!!!! The question is, does the rockets' common center of gravity move on after the explosion (b) or not (a)?
**F2** You push yourself away from your friend who is twice as heavy as you are. How fast do you move relative to one another? Can you explain why?
**F3** If you jump high in the air and land again, then obviously only your velocity has changed. Hoe does that fir with the Principle of Momemtum?
**F4 ▶L** What about if you drop a plate on the floor? Where does the vertical momentum come from that makes the plate fall and where does it go once the plate is on the floor? After breaking apart, where do the individual parts get their momentum?

**key words excerpt**
center of gravity – der Körperschwerpunkt
common center of gravity – der gemeinsame Körperschwerpunkt
linear momentum – Impuls
Conservation of Linear Momentum - Impulserhaltungssatz
mass – die Masse
velocity – die Geschwindigkeit
closed system – das abgeschlossene System
Law of Inertia – der Trägheitssatz

## Question box 10.2

**F5** A car rolls at 10 m/s into a parked car with the same weight. What is the cars' velocity at after the impact? What percent of kinetic energy transfers into heat?
**F6** The Barringer Crater in Arizona occurred when a meteor hit approximately 50,000 years ago. But where is the meteor now?
**F7** Is it better for guardrails next to streets to be more plastic or more elastic? Can you explain why this is so?
**F8 ▶L** Landing areas for ski jumping all look very similar. Why? Any why is landing in the flat part of the landing area so dangerous? Name the point marked by the flag below.

**key words excerpt**
elastic - elastisch
plastic - plastisch
heat – die Hitze, die Wärme
to collide - zusammenstoßen
guardrail – die Leitplanke
collision - die Kollision
impact – der Aufprall
crash – der Aufprall

## Question box 10.3

**F9** A billard ball crashes into the middle of another ball at 1 m/s without spin. How will the balls move after the crash?
**F10** What minimum mass does a hammer need to have relavtive to its chisel: lighter, heavier, or the same? Explain your answer.
**F11** Soccer shot. Why does your foot-speed decrease shortly before you kick the ball? Explain how it's possible that the ball's speed (about 120 km/h) is higher than your foot's (about 105 km/h)
**F12 ▶L** You throw equally heavy rubber and clay balls at a post. Which balls are more likely to knock the post over and which are more likely to damage the pole?

**key words excerpt**
billard ball – die Billardkugel
chisel – der Meißel
soccer – das Fußballspiel
rubber – der Gummi
clay – der Ton

## Question box 10.4

**F13** ▶**L** A mass of 1 kg falls from a height of 1m to the ground. Which force occurs at impact?
**F14** ▶**L** A swarm of flies is in a closed jar on a scale. Does the weight on the scale change if the flies sit or fly?
**F15** How old do you think the recoil technology for rockets engines is? Who "invented" it?

**keywords**
force – Kraft
recoil - Rückstoß
impulse - Kraftstoß

## Arbeitsbox Impuls

**F16** ▶**L** How large is the recoil of a gun which shoots 20 g bullets at 900 m/s? The barrel of the gun is 50cm long.
**F17** ▶**L** An open train wagon rolls along the tracks in the rain. Rain drops fall vertically. Which effect does the collected rain have on v and p? Then the rain stops and the water is drained out of the wagon. What is the change for v and p?
**F18** ▶**L** The meteorite, that formed the Barringer Crater, had a mass of about 1.5 $*10^8$ kg and impacted at about 12 km/s. How much has Earth moved due to this meterorite to this day?
**F19** ▶**L** In the figure a car (1 ton and 72 km/h) and a truck (3 tons and 24 km/h) approach an intersection. Which directions will each continue moving after impact?
**F20** ▶**L** Show that the unit for impulse (Ns) is equivalent to the unit for momentum ($kgms^{-1}$).
**F21** ▶**L** Does the weight of a sand clock change if the sand is moving or at rest? Shouldn't the weight be less if part of the sand is in free fall?
**F22** ▶**L** A scale always hovers around an average weight even if you stand perfectly still on it. Explain.
**F23** ▶**L** Newton's Cradle is a well known physics' toy. What happens if you lift 2 or 3 balls at once instead of just one? Can you explain why this is so?