

3 What Everything's Made Of

Elizabeth Steinberger und Martin Apolin

Question box 3.1

F1 If you keep splitting matter, will you eventually find a smallest particle which can no longer be split, or can you continue splitting matter indefinitely? Discuss arguments for and against infinite splitting of matter.

F2 Can you remember what an atom is made of?

F3 Have you ever heard that an Austrian was successful in beaming photons? What does "beaming photons" mean?

key words excerpt

indefinite – unbegrenzt

infinite – grenzenlos, unendlich

it consists of – es besteht aus

protons – die Protonen

neutrons – die Neutronen

nucleus – der Atomkern

electrons – die Elektronen

atoms – die Atome

shells – die Schalen

orbital – das Orbital

quant – das Quant

quantum mechanics – die Quantenmechanik

quantum teleportation – die Quantenteleportation

Question box 3.2

F4 Assume that an atom's nucleus was 1 cm. How big do you think the rest of the atom would be?

F5 ►L How many atoms do you think you can put behind on another in a line one cm long?

F6 Is there such a thing as a 100% smooth surface? Give reasons for your answer.

F7 Have you ever heard of quarks? What are they?

key words excerpt

smooth - glatt

electrical charge – die elektrische Ladung

neutral - neutral

Question box 3.3

F8 ►L Do you know what is so special about the elements hydrogen, mercury, bromine, and carbon?

F9 The big bang only produced the elements hydrogen and helium. Where in the world do all the other elements come from then?

F10 How many elements make up the human body? What about lower life forms like bacteria??

key words excerpt

hydrogen – der Wasserstoff

mercury – das Quecksilber

bromine – das Brom

carbon – der Kohlenstoff

periodic table – das Periodensystem

period – die Periode

group – die Gruppe

nuclear fusion – die Kernfusion

Question box 3.4

F11 What do you think the longest molecules in humans are?

F12 Why does a marble always roll to the lowest point in a bowl? And why is tea always in the bottom of a cup and why does it always have a smooth surface? Why do objects fall to the floor if you drop them?

key words excerpt

Molecule – die Moleküle

marble – die Kugel

Bonding – die Bindung

Ions – die Ionen

atomic – atomar

Question box 3.5

F13 How many molecules do you think are in a schnapps glass filled with 2 cl (centiliter) of water?

F14 Guess by which factor the density of steam is less than that of water.

F15 What do the numbers under the element name in the periodic table mean (fig. 3.11)? And how many times more mass does the heaviest element have compared to the lightest?

F16 ►L You mark the water molecules in a schnapps glass, pour the glass into the ocean, and stir well. How many atoms from your marked water are then in each liter in all the world's oceans?

key words excerpt

centiliter – der Zentiliter

density – die Dichte

steam – der Wasserdampf

element – das Element

schnapps glass – das Schnapsglas

to stir - durchmischen

atomic mass – die Atommasse

mole – das Mol

Question box 3.6

F17 What do the numbers mean in these expressions: C-12, Kr-86 and Cs-133?

F18 If the atomic mass unit (also called Dalton) is 1/12 of a C-12 atom, why is carbon's atomic mass 12.011 in the periodic table (fig. 3.11)? If this is so, then is the definition wrong?

F19 Why don't nucleons fly sky high out of the nuclei of atoms? The nucleus only has positive and neutral charges. How does the bonding take place?

F20 You've certainly heard of the equation $E = mc^2$! But do you know what it really means?

F21 In section 3.3 you heard about nuclear fusion, but do you know exactly where that incredible amount of energy comes from that the sun has emitted over billions of years?

key words excerpt

mass number – die Massenzahl

periodic table – das Periodensystem

atomic mass unit – die atomare Masseneinheit

nucleon – das Nukleon

isotopes – die Isotope

nuclear fusion – die Kernfusion

equation – die Gleichung

freed energy – die freigesetzte Energie

mass loss – der Masserverlust

Question box 3.7

F22 Do you know how the warp drive from Star Trek Enterprise works in theory?

F23 When you find a mummy like Ötzi how can you determine its age?

F24 Each student in a class of 32 stands up and tosses a coin. Whoever gets heads has to sit down. How many throws will it take in theory for just one student to remain standing?

F25 Is it possible to calculate randomness? Find arguments for and against it.

key words excerpt

warp drive – der Warp-Antrieb

to determine – feststellen, eruieren

randomness – der Zufall

statistics – die Statistik

radioactivity – die Radioaktivität

radiation – die Strahlung