

8 Newton times three

Elizabeth Steinberger und Martin Apolin

Question box 8.1

F1 You have a windowless laboratory on a racket. Sometimes the rocket is still on the ground, and sometimes it travels through space at 10 m/s. How can you (you = lab scientist working inside) tell the difference?

F2 ►L Look at figure 8.2. If you pull on the string quickly, then the string breaks under the weight. If you pull slowly, they the string will break above the weight. Can you explain why this is so?

F3 An elevator's cable suddenly snaps and the elevator is then in free fall to the ground. What do you experience inside the cabin?

key words excerpt

energy – die Energie

inertial mass – die träge Masse

gravitational mass – die schwere Masse

gravitational field – das Gravitationsfeld

Equivalence Principle – das Äquivalenzprinzip

Question box 8.2

F4 Look at figure 8.5. If you leave friction out of the picture, then a ball always rolls back to its original height. What happens if its course is completely horizontal?

F5 The Voyager 1 probe was sent into space in 1977, and had already reached a distance of 14 billion km from Earth in 2005. The Voyager does not have an engine to keep it going. How long will the probe continue its journey through space? a) 10 years, b) 1000 years, c) million years, or d) much longer. Explain your answer.

F6 You let a coin fall in an airplane moving at a very high speed. Where will it land? Exactly under you, or maybe farther ahead in the direction you're flying, or perhaps behind the direction you're flying. Give reasons for your answers. Is it the same when you jump into the air while traveling in a train?

F7 What is an inert system? In case you've forgotten, the re-read chapter 6.1.

key words excerpt

probe – die Sonde

inertial frame of reference – das Inertialsystem

inertial mass – die träge Masse

gravitational mass – die schwere Masse

law of inertia – der Trägheitssatz

Question box 8.3

F8 In fig. 8.12 you see a v/t-diagram of a strong car. The driver floors it twice for 50 seconds. In which of these two curves did the car have a heavier load? How many gears does the car have?

F9 Heavy Formula 1 pilots are at a disadvantage. What could it be? Why is it so important when you fill how much gasoline into the tank?

F10 What is the minimum acceleration necessary for a rocket to take off from the ground vertically: $>7 \text{ m/s}^2$, $>8 \text{ m/s}^2$, $>9 \text{ m/s}^2$ or $>10 \text{ m/s}^2$? Why do rockets always blast off in several stages?

key words excerpt

gear – der Gang (Auto), die Gangstufe

Formula 1 – die Formel 1

multistage – mehrstufig

rocket stage – die Raketenstufe

vertical – vertikal, senkrecht

Question box 8.4.1

F11 The 100 million dollar questions is what does a scale measure - mass or weight?

F12 A bathroom scale or a balance scale – which will also measure correctly on the moon?

F13 The Voyager 1 is 14 billion km away from earth (fig. 8.6), so is it far outside of earth's gravitational force? Or is it close, or not at all?

F14 ►L In space there is a table floating on which you place the earth. How much would earth weigh?

key words excerpt

mass – die Masse

weight – das Gewicht

bathroom scale – die Badezimmerwaage

balance scale – die Balkenwaage

billion – die Milliarde

Question box 8.4.2

F15 What takes more strength, pushing a box with the wider side down (large surface area) or pushing a box the narrower side down (smaller surface area)?

F16 When you pour water out of a glass slowly, the water runs down the outside of the glass. Why?

F17 ►L Late model cars have ABS, so called antiblock break system. What is its advantage?

key words excerpt

supporting area – die Auflagefläche

to pour out something – etwas ausleeren/ausschenken

antiblock break system – das Antiblockiersystem

friction force- die Reibungskraft

coefficient of friction – der Reibungskoeffizient

Question box 8.4.3

F18 What do the terms elastic and plastic mean? Can you think of materials with these characteristics?

F19 What happens when you tear your ligaments? Explain using the concepts elastic and plastic.

key words excerpt

elastic – elastisch

plastic – plastisch

ligament – das Band (med.)

to tear a ligament – ein Band zerren

Question box 8.5

F20 You are on a slick sheet of ice without any friction. You and your friend are the same weight and you pull yourselves toward one another on a rope. Where do you meet?

F21 You are on a zero gravity space station and push yourself away from your friend who is twice as heavy as you are. Do you float at the same speed or not? Explain your answer.

F22 On all Levi jeans' labels you see two horses pulling on a pair of jeans. Does it make any difference if you have two horses pulling or if just one horse pulls and the jeans are attached to a post?

F23 You accidentally floated away from the space station and you want to get back. What can you do, crawl, flounder? There is just one way.

key words excerpt

friction – die Reibung

zero gravity – die Schwerelosigkeit

to crawl – kralen

to flounder – zappeln

Task box

F24 ►L Why do you have to start slowly when you use a towing rope to tow a car? What could happen if you didn't?

F25 ►L How many meters does a Formula 1-car have to drive before it reaches 100 km/h, if its acceleration is 10 m/s?

F26 ►L In many films an humongous ship hovers over the ground. What is wrong with this picture?

F27 ►L The equation $F = ma$ states that a shotputter with more mass will also be more powerful. Or maybe not? Explain why this statement is true or false.

F28 ►L A small mass is attracted to a ball shaped pile of mass by a certain force. How does the force change if the pile is inflated but the center point remains the same? Is the force smaller or bigger, or unchanged?

F29 ►L What would your bathroom scale show if you stepped on it in space at zero gravity?

F30 ►L The total braking distance for a car is indirectly proportional to the coefficient of friction of the tires. Can you provide a mathematical formula for this statement? You will need the equation for brake distance from chapter. 6.4.2.

F31 ►L They say you should use second gear when the streets are slick. Why?

F32 ►L A violin bow and an oil door hinge have something in common. What is it?

F33 ►L The picture shows a flight simulator in which flight is not only visually imitated, but somatically as well. How does it work and what is the maximum limit on simulated acceleration?